REGION 5 RAC2

REMEDIAL ACTION CONTRACT FOR

Remedial, Enforcement Oversight, and
Non-Time Critical Removal Activities at Sites of Release
or Threatened Release of Hazardous Substances in Region 5

UNIFORM FEDERAL POLICY QUALITY ASSURANCE PROJECT PLAN

OMC Waukegan Harbor Site
Remedial Action
Waukegan, Illinois

WA No. 137-RARA-0528/Contract No. EP-S5-06-01

July 2012

PREPARED FOR

U.S. Environmental Protection Agency

PREPARED BY

CH2M HILL
Ecology and Environment, Inc.
Environmental Design International, Inc.
Teska Associates, Inc.
Critigen, LLC

FOR OFFICIAL USE ONLY

Quality Assurance Project Plan

OMC Waukegan Harbor Site Waukegan, IL

Remedial Action

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CH2MHILL®

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Acronyms and Abbreviations

ASM	Assistant Site Manager
CF	consolidation facility
CM	Construction Manager
COC	contaminant of concern
CRL	Central Regional Laboratory
°C	degrees Celsius
DQI	data quality indicator
EB	equipment blank
FD	field duplicate
FOP	field operating procedure
FTL	Field Team Leader
GC/ECD	gas chromatography/electron capture detector
GC/MD	gas chromatographic/multi-detector
GC/MS	gas chromatograph/mass spectrometer
LCS	laboratory control sample
MB	method blank
MDL	method detection limit
µg/m^3	micrograms per cubic meter
µg/L	micrograms per liter
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
OMC	Outboard Marine Corporation, Inc.
OU	operable unit
PAL	project action level
PC	Project Chemist
PCB	polychlorinated biphenyl
PCM	phase contrast microscopy
ppm	part per million
PUF	polyurethane foam
QA	quality assurance
QC	quality control
QAPP	Quality Assurance Project Plan

QL	quantitation limit
RPD	relative percent difference
RSD	relative standard deviation
SM	Site Manager
SOP	standard operating procedure
STC	Senior Technical Consultant
TAT	turnaround time
TBD	to be determined
TSP	total solid particulate
TSS	total suspended solids
UFP	Uniform Federal Policy
USACE	U.S. Army Corp of Engineers
USEPA	U.S. Environmental Protection Agency
yd^3	cubic yards

Worksheet #1—Title and Approval Page

(Uniform Federal Policy [UFP] Quality Assurance Project Plan [QAPP] Section 2.1)

Site Name/Project Name: Outboard Marine Corporation, Inc. (OMC) Waukegan Harbor Site Remedial Action

Site Location: Waukegan, IL

Document Title: QAPP OMC Waukegan Harbor Site, Remedial Action

Lead Organization: U.S. Environmental Protection Agency (USEPA)

Preparer's Name and Organizational Affiliation: Megan Morrison/CH2M HILL

Preparer's Address, Telephone Number, and E-mail Address: 15010 Conference Center Drive, Suite 200, Chantilly, VA, 20151; (703) 376-5053; Megan.Morrison@ch2m.com.

Preparation Date (Day/Month/Year): 7/3/2012

Investigative Organization's Site Manager/Date: _____
Signature

Printed Name/Organization: Jewelle Keiser/CH2M HILL

Investigative Organization's Project Quality Assurance (QA) Officer/Date: _____
Signature

Printed Name/Organization: Paul Arps/CH2M HILL

Lead Organization's Project Manager/Date: _____
Signature

Printed Name/Organization: Tim Drexler/USEPA

Approval Signatures/Date: _____
Signature

Printed Name/Title: Warren Layne/ USEPA Quality Assurance

Approval Authority: USEPA Region 5

Document Control Numbering System: WH-RA-R0

Worksheet #2—QAPP Identifying Information

(UFP QAPP Section 2.2.4)

Site Name/Project Name: OMC Waukegan Harbor Site

Site Location: Waukegan, IL

Site Number/Code: Not applicable

Operable Unit: 1

Contractor Name: CH2M HILL

Contractor Number: EP-S5-06-01

Contract Title: Remedial Action Contract 2

Work Assignment Number: 137-RARA-0528

Title: QAPP—OMC Waukegan Harbor Site Remedial Action

Revision Number: 0

Revision Date: July 2012

1. Identify regulatory program:

   The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, commonly known as Superfund

2. Identify approval entity:

   USEPA Region 5

3. The QAPP is (select one): ☐Generic ☒Project Specific

4. List dates of scoping sessions that were held: Not applicable

5. List dates and titles of QAPP documents written for previous site work, if applicable:

Title	Approval Date
QAPP—Waukegan Harbor Area of Concern Remedial Action	September 2007

6. List organizational partners (stakeholders) and connection with lead organization:

   USEPA Region 5 (lead organization)
   Illinois Environmental Protection Agency (lead state regulatory agency)
   City of Waukegan (local agency; property owner)

7. List data users:

   USEPA, CH2M HILL

8. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusions below:

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	Worksheet #1
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	- Table of Contents - QAPP Identifying Information	Worksheet #2
2.3. Distribution List and Project Personnel Signoff Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Signoff Sheet	- Distribution List - Project Personnel Signoff Sheet	Worksheet #3 Worksheet #4
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table	Worksheet #5 Worksheet #6 Worksheet #7 Worksheet #8
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)	Basis of Design Report (CH2M HILL 2010) Worksheet #10
2.6. Project Quality Objectives and Measurement Performance Criteria 2.6.1. Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-specific Project Quality Objectives - Measurement Performance Criteria Table	Worksheet #11 Worksheet #12
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table	Worksheet #13
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table	Worksheet #14 Worksheet #15 Worksheet #16

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table - Analytical Methods/SOP Requirements Table - Field Quality Control Sample Summary Table - Sampling SOPs - Project Sampling SOP References Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table	Worksheet #17 Worksheet #18 Worksheet #19 Worksheet #20 Worksheet #21 Worksheet #22
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Worksheet #23 Worksheet #24 Worksheet #25
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	- Sample Collection Documentation Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-custody Form and Seal	Worksheet #27
3.4 Quality Control (QC) Samples 3.4.1 Sampling QC Samples 3.4.2 Analytical QC Samples	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree	Worksheet #28
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs	Worksheet #29 Worksheet #30

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments Table - Audit Checklists - Assessment Findings and Corrective Action Responses Table	Worksheet #31 Worksheet #32
4.2 Quality Assurance Management Reports	- QA Management Reports Table	Worksheet #33
4.3 Final Project Report		
Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	- Verification (Step I) Process Table - Validation (Steps IIa and IIb) Process Table - Validation (Steps IIa and IIb) Summary Table - Usability Assessment	Worksheet #34 Worksheet #35 Worksheet #36 Worksheet #37
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining		

Worksheet #3—Distribution List

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Tim Drexler	Region 5 Remedial Project Manager	USEPA	312-353-4367	TBD	Drexler.Timothy@epamail.epa.gov	WH-RA-R0-01
Warren Layne	Region 5 QA Reviewer	USEPA	312-886-7336	TBD	Layne.Warren@epa.gov	WH-RA-R0-02
Ike Johnson	Program Manager	CH2M HILL	414-847-0304	414-272-4408	Ike.Johnson@ch2m.com	WH-RA-R0-03
Paul Arps	Quality Assurance Manager	CH2M HILL	262-349-4180	414-272-4408	Paul.Arps@ch2m.com	WH-RA-R0-04
Jewelle Keiser	Site Manager (SM)	CH2M HILL	414-847-0469	414-272-4408	Jewelle.Keiser@ch2m.com	WH-RA-R0-05
Bill Andrae	Assistant Site Manager (ASM)	CH2M HILL	414-847-0341	414-272-4408	William.Andrae@ch2m.com	WH-RA-R0-06
Dan MacGregor	Project Quality Manager	CH2M HILL	414-847-0424	414-454-8780	Dan.MacGregor@ch2m.com	WH-RA-R0-07
Keli McKenna	Project Engineer	CH2M HILL	414-272-0561	414-454-8784	Keli.McKenna@ch2m.com	WH-RA-R0-08
Mike Jury	Senior Technical Consultant (STC)	CH2M HILL	414-847-0363	414-272-4408	Mike.Jury@ch2m.com	WH-RA-R0-09
Jeff Lamont	Construction Manager (CM)	CH2M HILL	414-847-0314	414-272-4408	Jeffrey.Lamont@ch2m.com	WH-RA-R0-10
Mike Lehman	Resident Inspector	CH2M HILL	414-847-0327	414-272-4408	Michael.Lehman@ch2m.com	WH-RA-R0-11
Jeff Rodencal	Resident Inspector	CH2M HILL	414-272-1052	414-454-8879	Jeffrey.Rodencal@ch2m.com	WH-RA-R0-12
Dave Shekoski	Sampling and Analytical Coordinator	CH2M HILL	414-847-0345	414-272-4408	Dave.Shekoski@ch2m.com	WH-RA-R0-13
Megan Morrison	Project Chemist (PC)	CH2M HILL	703-376-5053	703-376-5466	Megan.Morrison@ch2m.com	WH-RA-R0-14
Cherie Wilson	Project Controls Technician	CH2M HILL	414-847-0219	414-272-4408	Cherie.Wilson@ch2m.com	WH-RA-R0-15
TBD	Project Manager	Subcontracted Laboratory	TBD	TBD	TBD	WH-RA-R0-16

Note:

TBD = to be determined

Worksheet #4—Project Personnel Signoff Sheet

Organization: USEPA

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Tim Drexler	Region 5 Remedial Project Manager	312-353-4367		
Warren Layne	Region 5 QA Reviewer	312-886-7336		

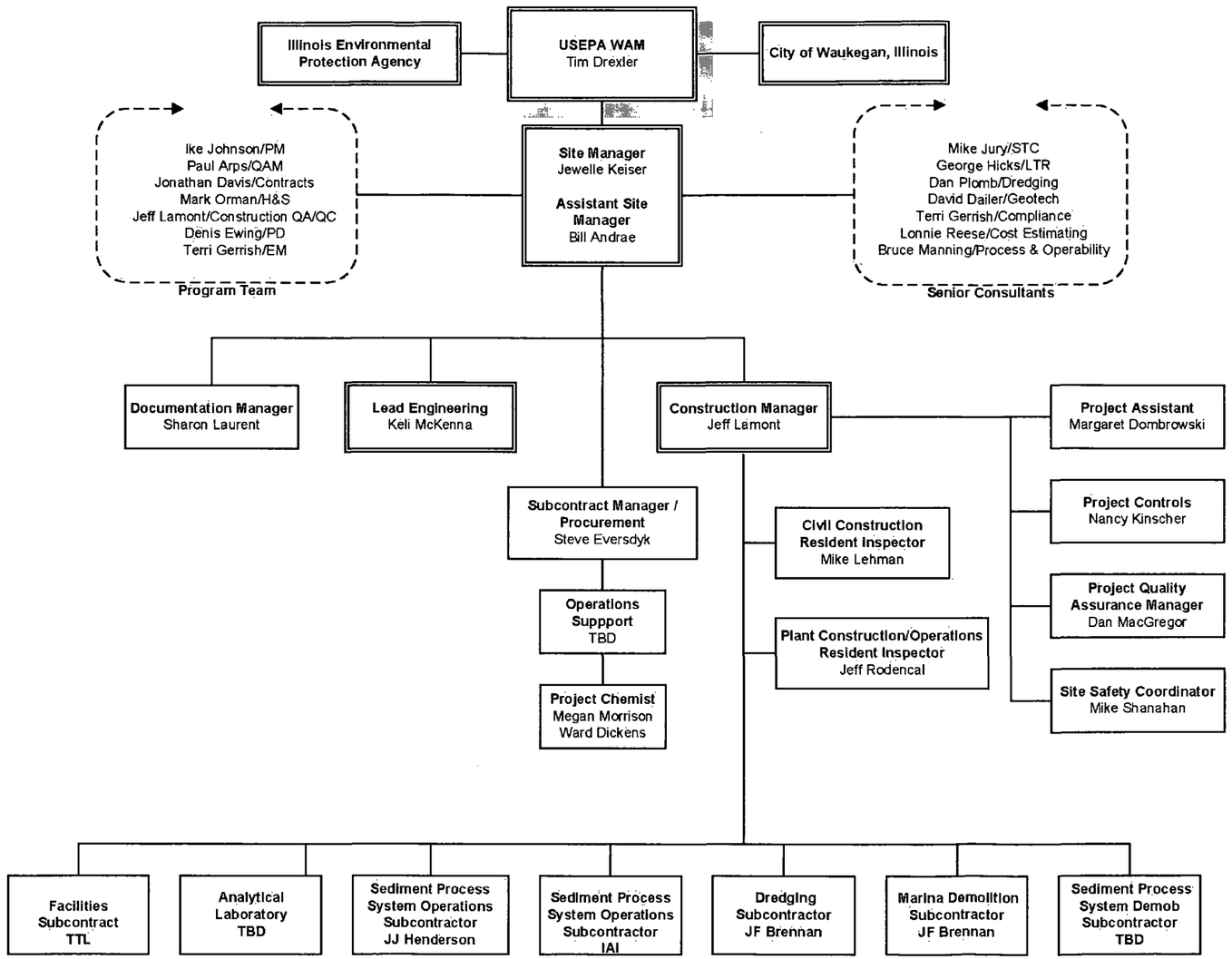
Organization: CH2M HILL

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Ike Johnson	Program Manager	414-847-0304		
Paul Arps	QA Manager	262-349-4180		
Jewelle Keiser	SM	414-847-0469		
Bill Andrae	ASM	414-847-0341		
Dan MacGregor	Project Quality Manager	414-847-0424		
Keli McKenna	Project Engineer	414-272-0561		
Mike Jury	STC	414-847-0363		
Jeff Lamont	CM	414-272-0314		
Mike Lehman	Resident Inspector	414-847-0327		
Jeff Rodencal	Resident Inspector	414-272-1052		
Megan Morrison	PC	703-376-5053		

Organization: Subcontracted Laboratory, TBD

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
TBD	Project Manager	TBD		

Worksheet #5—Project Organizational Chart



Worksheet #6—Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Point of contact with USEPA Remedial Project Manager	CH2M HILL SM	Jewelle Keiser	414-847-0469	All materials and information about the project will be forwarded to Tim Drexler by Jewelle Keiser.
Manage all project phases	CH2M HILL SM	Jewelle Keiser	414-847-0469	Notify Tim Drexler of field-related problems by next business day. Serious QA/QC issues will be reported to Jewelle Keiser and Paul Arps by the CM.
Technical communications for project implementation and data interpretation	ASM	Bill Andrae	414-847-0341	Contact ASM regarding questions/issues encountered in the field, input on data interpretation, as needed. ASM will communicate, as necessary, with Mike Jury, the STC and have 24 hours to respond to technical field questions. Responses will be communicated to the SM by e-mail or phone.
Health and safety	Resident Inspector and CM	Jeff Rodencal, Mike Lehman and Jeff Lamont	414-272-1052	The field managers are responsible for the adherence of team members to the site safety requirements described in the health and safety plan. Will report health and safety incidents and near misses to SM.
QAPP changes in the field	Resident Inspectors CM	Jeff Rodencal, Mike Lehman Jeff Lamont	414-272-1052, 414-847-0327 414-272-0314	The field team leader (FTL) will notify the CM by phone and e-mail of changes to the QAPP made in the field and the reasons within 24 hours. The CM will communicate directly with the SM. Documentation of deviations from the Work Plan will be kept in the field logbook; deviations made only with the approval of the contractor SM. The SM will advise Tim Drexler of all changes.
Field progress reports	Resident Inspectors	Jeff Rodencal, Mike Lehman	414-272-1052, 414-847-0327	E-mail daily field progress reports to CM and project quality manager. CM will provide weekly summary reports to SM. All reports will beposted to the project SharePoint site.
Field corrective actions	Resident Inspectors	TBD	TBD	The need for corrective action for field issues will be determined by the CM. The ASM will ensure QAPP requirements are met by field staff. The resident inspectors will notify the CM of any needed field corrective actions. The CM will notify the project quality manager and SM and have 24 hours to respond to the request for field corrective action.
Reporting lab data quality issues	Central Regional Laboratory (CRL) and Subcontracted Laboratory	TBD	TBD	All QA/QC issues with field samples will be reported to the PC immediately.
Analytical corrective actions	PC	Megan Morrison	703-376-5053	The need for corrective action by the analytical laboratory will be determined by the PC. The PC will ensure QAPP requirements are met by the laboratory. No analytical data can be released until data is reviewed for completeness and conformance to analytical guidelines by the PC. The PC will review all data as soon as possible upon receipt from the validator.
Release of analytical data	CRL and Subcontracted Laboratory	TBD	TBD	No analytical data can be released to CH2M HILL and USEPA until it has been reviewed by the laboratory (subcontracted laboratory).
QAPP amendments	Region 5 Remedial Project Manager	Tim Drexler	312-353-4367	Any major changes to the QAPP must be approved before the changes can be implemented.

Worksheet #7—Personnel Responsibilities and Qualification Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Tim Drexler	Region 5 Remedial Project Manager	USEPA	Overall responsibility for all phases of work, review, and approval	TBD
Warren Layne	Region 5 QA Reviewer	USEPA	QAPP review and approval	TBD
Ike Johnson	Program Manager	CH2M HILL	Overall responsibility for meeting USEPA objectives and CH2M HILL quality standards, as well as technical QCand project oversight; QAPP review	M.S. and B.S., 32 years of experience
Paul Arps	QA Manager	CH2M HILL	QA review	B.A., 12 years of experience
Jewelle Keiser	SM	CH2M HILL	Administrative, decision, and approval authority;	M.S. and B.S., 27 years of experience
Bill Andrae	ASM	CH2M HILL	Assists the SM; design team leader	M.S. and B.S., 25 years of experience
Mike Jury	STC	CH2M HILL	Provides technical design expertise to support design implementation during construction	M.S. and B.S., 38 years of experience
Dan MacGregor	PQM	CH2M HILL	Verifies effectiveness of project QA. Reviews and evaluates processes in place; implements improvements as necessary	M.S. and B.S., 20 years of experience
Jeff Lamont	CM	CH2M HILL	Overall construction management	M.S. and B.S., 30 years of experience
Mike Lehman	Resident Inspector	CH2M HILL	Responsible for verifying construction being implemented in accordance with the plans and specifications; ensures adherence to the QAPP and communicate issues to SM and field team; contractor oversight; oversees health and safety for all field activities	M.S. and B.S., 13 years of experience
Jeff Rodencal	Resident Inspector	CH2M HILL	Responsible for verifying construction being implemented in accordance with the plans and specifications; ensures adherence to the QAPP and communicate issues to SM and field team; contractor oversight; oversees health and safety for all field activities	4 years of honorable military service, 15 years of experience
Keli McKenna	Project Engineer	CH2M HILL	Supports implementation of the sediment remediation component of the remedial action as needed, including technical field support and confirmation sampling	B.S., 15 years of experience
Megan Morrison	PC	CH2M HILL	Coordinates with field team, SM, subcontracted laboratory, data management	B.S., 6 years of experience

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Mark Orman	Health and Safety Operations Manager	CH2M HILL	Responsible for all aspects of program health and safety, including review and approval of the subcontractor's health and safety submittals, as well as monitoring and enforcing the team's compliance with the site-specific health and safety plan	B.S., 16 years of experience
Dave Shekoski	Sampling and Analytical Coordinator	CH2M HILL	Coordinate field and laboratory schedules, sample management	A.S., 25 years of experience

Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training Title or Description of Course	Training Provider	Training Date	Personnel/ Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/ Certificates
Safety Coordinator	Safety Coordinator—Hazardous Waste	Registered training organization	Various	Safety Coordinator	Safety Coordinator from CH2M HILL	Contractor, human resources department
Hazardous Waste Site Worker	Occupational Safety and Health Administration 40-Hour Health and Safety Training	Various	Various	All field personnel and subcontracted project personnel working in the field	All field personnel from CH2M HILL and subcontracted personnel	CH2M HILL
Health and Safety	Health and Safety Plan	CH2M HILL	Various, project specific	All field personnel and subcontracted project personnel working in the field	All field personnel from CH2M HILL and subcontracted personnel	Signoff sheet at the end of the health and safety plan

Worksheet #9—Project Scoping Session Participants Sheet

Not applicable. This UFP QAPP is based on requirements in the basis of design report (CH2M HILL 2010).

Worksheet #10—Problem Definition

The Problem to be Addressed by the Project

The RA will be based on the *Basis of Design Report for OMC Waukegan Harbor (OU1)* (CH2M HILL 2010). The remedial action includes dredging to remove sediments contaminated with the polychlorinated biphenyls (PCBs) and dispose of the material in a consolidation facility (CF) located on the OMC Plant 2 property.

Site Description and History

Site Description

Waukegan Harbor is located on the western shore of Lake Michigan, about 40 miles north of Chicago, Illinois, in the City of Waukegan, Illinois. Based on current uses and historical activities, the harbor was divided into the following harbor segments: Outer Harbor, Entrance Channel, Inner Harbor, Marina, Inner Harbor Extension, Slip 1, North Harbor (includes Slip 4), as shown in Figure 1.

The federal navigation channel of Waukegan Harbor includes the Outer Harbor, Entrance Channel, Inner Harbor, and Inner Harbor Extension. Although it is part of the federal navigational channel, remediation of the Outer Harbor segment is not required and, therefore, was not included in the design.

The harbor is a mostly man-made structure, covering an area of 35 to 40 acres and with water depths between 8 and 24 feet. The harbor sediments consist of less than 1 to 7 feet of very soft organic silt overlying medium-dense fine to coarse sand. Underlying the sand is very stiff clay till. The entire harbor is bordered by sheet pile bulk heads, except in the Waukegan Port District boat launching areas and at the retaining wall near the harbor mouth. The harbor area, including utility locations, is shown in Figure 2. Waukegan Harbor is an industrial and commercial harbor used by lake-going freighters and recreational boaters. Slip 4 (part of the North Harbor segment) is used for repair, supply, and as a docking facility for private boats (Larsen Marine Service). Presently, Slip 1 is the only operating slip for commercial traffic and is used by National Gypsum, Lafarge Corporation, and St. Mary's Cement, Inc. Recreational boat traffic uses Slip 4 and the public marina in the southwest corner of the harbor.

The U.S. Army Corp of Engineers (USACE) is responsible for maintaining the depth of the federal channel at 18 feet below the low water datum for Lake Michigan. However, USACE has not dredged the harbor since the early 1970s because of the PCB contamination in the sediment. Currently, the PCB concentration of the surface sediments in the Outer Harbor is less than 1 part per million (ppm). The sediment present above -18 feet low water datum could be dredged by USACE once a disposal location is identified.

The current land uses surrounding the harbor are primarily marine-recreational and industrial, but utilities (City of Waukegan Water Plant) and a public beach are also on the east side of the harbor peninsula. The locations of the current entities surrounding the harbor are shown in Figure 1.

Waukegan Harbor is contiguous with Lake Michigan and has no tributary flows. Lake Michigan influences Waukegan Harbor in several ways. Most significantly, the nearly continual exchange of water between the lake and harbor, caused predominantly by wind-induced seiches, prevents stagnation of the harbor water. In addition, large ships and tug boats resuspend large amounts of sediment when using props and bow thrusters to maneuver within the navigational channel.

Site Background and Secondary Data

Waukegan Harbor is part of the OMC Superfund Site. The OMC site includes four operable units (OUs): the Waukegan Harbor Sites (OU1 and OU3), the Waukegan Coke Plant Site (OU2) on the eastern edge of the harbor, and the OMC Plant 2 Site (OU4) north of the harbor (Figure 2). OMC Plant 2 is the source of the PCB contamination in Waukegan Harbor sediments. In February 1992, OMC completed a sediment remediation project in the harbor that entailed the dredging, treatment, and disposal of about 38,000 cubic yards (yd^3) of PCB-contaminated sediment from the North Harbor area. Dredged sediments were placed in a permanent containment cell constructed in the

former Slip 3. Remediated sediments contained an estimated 1,000,000 pounds of PCBs with a maximum PCB concentration of 500,000 ppm. Sampling of surficial sediments conducted in 1996 indicated moderate levels of PCB contamination throughout the harbor from the North Harbor area to the Entrance Channel.

OMC dredged the northern harbor area to achieve a cleanup level of 50 ppm for total PCBs. However, fish tissue samples still contain high levels of PCBs. Remaining total PCB concentrations in sediments range from nondetected to approximately 32 ppm with an average concentration of about 2 to 3 ppm. Sediment sampling locations and maximum locations are shown in Figure 3. A risk evaluation performed in 2006 estimated that in order to achieve acceptable PCB levels in fish for unrestricted consumption, the total PCB levels in sediments would need to be lowered to an overall surface-weighted average concentration of 0.2 ppm (CH2M HILL 2006).

The Record of Decision Amendment issued by USEPA in October 2009 presented the selected remedy, which consists of dredging, dewatering the dredged sediment using geotextile tubes that would remain on the OMC Plant 2 Site, and treating and then discharging water back into the harbor (Figure 4). The selected remedy was carried forward through the design process as presented in the *Basis of Design Report for OMC Waukegan Harbor (OU1)* (CH2M HILL 2010).

The primary objective of the remediation project is to address the following risk-related remedial action objectives presented in the Record of Decision Amendment (USEPA 2009):

- Protect human health and the environment from the adverse effects of PCBs attributable to the site.
- Reduce PCBs in sediment throughout the harbor to a remedial action level of 1 ppm at any single location and an overall surface-weighted average concentration of 0.2 ppm.
- Minimize potential human health and environmental risks that may be associated with remedial activities to the extent practicable.

The Rationale for Inclusion of Chemical and Nonchemical Analyses

The contaminants of concern (COCs) are based on previous site investigations. The selected COCs present the greatest human health and environment concerns and are found at the highest concentrations. Other analytical and field parameters will be collected to assess site conditions due to remediation activities.

Information Concerning Various Environmental Indicators

Based on previous investigations and the risk evaluation performed using site data, the main remedial action objectives include protecting human health and the environment from adverse impacts of PCBs attributable to the site and minimizing potential human health and environmental risk that may be associated with the remedial activities to the extent practicable. Because PCBs do not appreciably degrade or easily attenuate and have remained bioavailable in the harbor, dredging will be conducted to reduce the environmental risks associated with exposure to PCB-contaminated harbor sediments. The removal of the PCB-impacted sediment will be documented by post-dredging bathymetric surveys. In addition, a clean cover layer will be placed on the post-dredged surface to reduce residual PCB concentrations.

The present environmental site conditions are described in the basis of design report (CH2M HILL 2010).
In addition to PCBs, the following parameters will be monitored during operations:

- Total suspended solids (TSS) and turbidity. Background measurements of turbidity and TSS will be taken before dredging begins. The comparison of TSS/turbidity during dredging with background levels will be used to monitor the effectiveness of best management practices being implemented to minimize re-suspension during dredging operations. Analysis of the treatment effluent will be used to monitor the effectiveness of metals and PCB removal associated with TSS.
- Ammonia. During the elutriate testing, the maximum concentration of total ammonia recorded in the harbor was 14.4 milligrams per liter (mg/L) and the background ammonia concentration was 0.5 mg/L. The water

quality standard for waters of the Lake Michigan Basin for total ammonia is 15 mg/L. The un-ionized ammonita concentrations were calculated based on the total ammmonia at various temperatures and pH valuess. It was determined to achieve the acute un-ionized ammonia water quaility standard, harbor water will be added to the water treatment system effluent during the months of April and October. The ammonia levels will be monitored to verify that standards are being achieved.

- PCBs, asbestos and total solid particulates (TSP) in air. The potential presence for asbestos in the harbor sediment will be monitored due to numerous possible sources of asbestos located north of the harbor entrance. Air monitoring for PCBs, asbestos, and TSP will be conducted to document levels prior to and during the initiation of dewatering operations. The results will be used to verify the adequate engineering controls to minimize dust are being implemented.

Dredging and dewatering operations will be performed 24 hours per day, 5 days per week (Monday through Friday), with downtime for maintenance and repairs on the weekends. The anticipated working season for dredging activities is April through November, depending on weather conditions. It will be necessary to schedule activities to accommodate the current commercial and industrial uses of the harbor. The following have been identified as activities to be considered:

- Larsen Marine Service has floating docks that are removed during the offseason months, which would allow for unobstructed dredging in this area if it can be completed before the docks are reinstalled for the summer months.
- Coordination with the arrival and departure of commercial ships delivering raw materials to the local industry will be required.
- Coordination with winterizing the water treatment system and CF will be required.

Based on discussions with the City of Waukegan, no additional limitations on hours of operation will be placed on the work.

Project Decision Conditions

The performance standards for the project consist of the following:

- If sediment has been removed to specified elevations for at least 95 percent of the dredged area and to within 0.5 foot of 99 percent of the dredged area, then dredging is complete. This is determined by comparing pre- and post-dredging bathymetric surveys.
- If TSS values exceed 15 mg/L above the harbor's TSS background level (measured at the monitoring point located at the harbor entrance, see Figure 4), then it is assumed that turbidity values exceed 15 nephelometric turbidity units above background levels. Based on other dredging projects, the correlation between TSS and turbidity is approximately 1:1. If the turbidity upper criterion is exceeded, then dredging will be halted temporarily until turbidity levels decrease below the criterion.
- If the treatment standards for total ammonia nitrogen or unionized ammonia nitrogen are exceeded as calculated with the actual effluent water temperature and pH, the dredging in the harbor will be halted until the standard can be achieved.
- If the water treatment system effluent discharge limits are exceeded, then the treatment system will be re-evaluated to determine a way to meet performance standards given in Worksheet #15.
- If air monitoring during dewatering of the sediment reveals PCB, asbestos, or TSP above the preconstruction baseline conditions, then additional engineering controls will be implemented to reduce dust emissions.

Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

Who Will Use the Data?

The data will be used by CH2M HILL and USEPA.

What Will these Data be Used For?

The data from various sources will be used to monitor site conditions during dredging, dewatering, and treatment plant discharge activities.

What Types of Data are Needed? (target analytes, analytical groups, field screening, onsite analytical or offsite laboratory techniques, sampling techniques)

TABLE 1

Data Needs

Task	Sampling Activity/ Objective	Sampling Frequency/ Duration	Field Screening or Offsite Analytical Laboratory	Matrix	Parameters
Water Treatment Effluent Discharge Samples					
24-hour composite samples	Determine if water meets treatment system effluent discharge limits	Initial samples: Collected daily for 2-week period each season. Results within 72 hours. Remaining samples: Collected weekly for duration of treatment plant operations. Results on a standard turnaround time (TAT).	Offsite analytical laboratory; initial samples to subcontracted laboratory (TBD), remaining samples to subcontracted laboratory (PCBs or TSS) or CRL (TSS).	Effluent Water	PCBs[a], TSS
Composite samples from top and bottom thirds of water column		Daily, collected in harbor 500 feet from discharge point	Offsite analytical laboratory; initial samples to subcontracted laboratory (TBD).	Harbor Water	Chronic ammonia
Continuous inline samples		Continuous; measured by inline instrumentation.	Field Screening	Effluent Water	pH
Water Treatment System Processing Monitoring (Collected and analyzed using inline instrumentation)					
Continuous inline samples	Monitor treatment process	Continuous	Field Screening	Treatment Water	Flow, Density (percent solids), Turbidity, Chlorine, Temperature, pH
Water Quality Monitoring—Harbor Background Samples					
Grab samples	Establish background concentrations for comparison to monitoring data	Daily for first 2 weeks of the season before dredging begins at locations representative of background conditions. Results on a 72-hour TAT.	Offsite analytical laboratory; sent to subcontracted laboratory (TBD).	Harbor Water	TSS
		Daily for first 30 days of each season at the entrance of the harbor before each dredge season begins. Results on a 72-hour TAT.			Ammonia

TABLE 1

Data Needs

Task	Sampling Activity/ Objective	Sampling Frequency/ Duration	Field Screening or Offsite Analytical Laboratory	Matrix	Parameters
Harbor Dredging Samples					
Grab samples	Monitor re-suspension of sediment during dredging	Daily samples throughout dredging operations.	Subcontracted laboratory (TBD)	Harbor Water	Ammonia
		Daily using backscatter nephelometer with an underwater sensor and direct surface readout.	Field Screening		Turbidity
		Daily for first 2 weeks during each season (April–October or November–March) in vicinity of turbidity monitoring location. Results within 72 hours. Once a correlation between turbidity and TSS is established, samples will be collected weekly. Results on a standard TAT.	Offsite analytical laboratory; initial samples to subcontracted laboratory (TBD), remaining samples to CRL or subcontracted laboratory		TSS
Air Monitoring Samples—Geotextile Tube Dewatering					
Air Monitoring Samples	Document PCB and asbestos levels prior to and during the initiation of dewatering operations	Samples will be collected at four locations before initiation of construction to establish a baseline condition and during the first month of operations to verify the engineering controls to minimize dust are being implemented properly.	Offsite analytical laboratory; sent to subcontracted laboratory (TBD)	Ambient Air	PCBs[a], Asbestos
			Offsite to CRL or subcontracted laboratory		TSP

[a] PCBs include Aroclors 1221,1242, 1248, 1254, and 1260. Aroclors will be summed to obtain a Total PCBs result. Where a mix of detects and nondetects appear for a specific Aroclor, the quantitative value for detected Aroclors will be added to the method detection limit (MDL) for each of the nondetected Aroclors. If the Total PCB concentration is not detected, the PCB concentration will be represented as the sum of each individual Aroclor's MDL.

How "Good" Do the Data Need to be in Order to Support the Environmental Decision?

The data should meet the project action levels (PALs) as specified in QAPP Worksheet #15 and the QC requirements that are explained in QAPP Worksheets #12, 24, 25, and 28. The data will be generated using analytical methods such as approved USEPA SW-846, or other published reference methods, and are not restricted in their use unless there is a quality issue associated with the data.

How Many Data are Needed? (number of samples for each analytical group, matrix, and concentration)

See Worksheet #20 for field sample and QC sample counts.

Where, when, and how should the data be collected/generated?

Detailed information on where, when, and how the data will be collected is provided in Worksheets #14, 17, 18, and 21.

Who will collect and generate the data?

CH2M HILL will collect environmental samples on behalf of USEPA. The dredging subcontractors may assist with sample collection or mobilization. Field screening data will be generated onsite as shown in Table 1. An offsite analytical data will be generated by a subcontracted laboratory (TBD) for quick TAT results; the subcontracted laboratory (TBD) and CRL laboratory will generate the standard TAT data.

How will the data be reported?

Full Contract Laboratory Program or Contract Laboratory Program-like reporting is required for all non-field analytical data. The data will be reported in accordance with procedures outlined in Worksheet #36 (Verification [Steps IIa and IIb] Summary).

How will the data be archived?

See Appendix A, Data Management Plan. Hard copy and electronic data, such as database management system and geographic information system, will be stored by CH2M HILL for 5 years after project completion. Project reports will be archived on CD-ROM or DVD+R media and stored in the project file.

Worksheet #12-1—Measurement Performance Criteria Table

Matrix Water

Analytical Group PCBs

Concentration Level Low

Sampling Procedure[a]	Analytical Method/SOP[b]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
Field operating procedure (FOP) See Worksheet #21	SW-846 8082/ TBD	Precision	RPD ± 30%	MS/MSD, FD	S & A
		Accuracy/Bias	Within Percent Recovery range	LCS, MS/MSD	A
		Completeness	> 90% Laboratory Analysis	Percent Completeness	S & A
		Accuracy/ Bias, Contamination	Contamination of sample or extract with a COC	MB, Instrument blank	S & A
		Representativeness	Cooler temperature 4 degrees Celsius (°C) ± 2°C	Cooler temperature blank	S

[a]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[b]Reference number from QAPP Worksheet #23 (see Section 3.2)
EB = equipment blank, FD = field duplicate; LCS = laboratory control sample, MB = method blank, MS = matrix spike, MSD = matrix spike duplicate, RPD = relative percent difference

Worksheet #12-2—Measurement Performance Criteria Table

Matrix Water

Analytical Group TSS

Concentration Level Medium

Sampling Procedure[a]	Analytical Method/SOP[b]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
FOP See Worksheet #21	SM2540D CRL Method/TBD	Precision	RPD ± 30%	FD	S & A
		Completeness	> 90% Laboratory Analysis	Percent Completeness	S & A
		Representativeness	Cooler temperature 4°C ± 2°C	Cooler temperature blank	S

[a]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[b]Reference number from QAPP Worksheet #23 (see Section 3.2)

Worksheet #12-3—Measurement Performance Criteria Table

Matrix Water

Analytical Group Ammonia

Concentration Level Medium

Sampling Procedure[a]	Analytical Method/SOP[b]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
FOP See Worksheet #21	SM 4500-NH3	Precision	RPD ± 30%	MS/MSD, FD	S & A
		Accuracy/Bias	± Percent Recovery	LCS, MS/MSD	A
		Completeness	> 90% Laboratory Analysis	Percent Completeness	S & A
		Accuracy/Bias, Contamination	Contamination of sample or extract with a COC	MB	S & A
		Representativeness	Cooler temperature 4°C ± 2°C	Cooler temperature blank	S

[a]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[b]Reference number from QAPP Worksheet #23 (see Section 3.2)

Worksheet #12-4—Measurement Performance Criteria Table

Matrix Air

Analytical Group PCBs

Concentration Level Low

Sampling Procedure[a]	Analytical Method/SOP[b]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
FOP See Worksheet #21	TO-10A	Precision	RPD ± 30%	MS/MSD	S & A
		Accuracy/Bias	± Percent Recovery	MS/MSD	A
		Completeness	> 90% Laboratory Analysis	Percent Completeness	S & A
		Accuracy/Bias, Contamination	Contamination of sample or extract with a COC	Process blank, field blank, MB	S & A

[a]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[b]Reference number from QAPP Worksheet #23 (see Section 3.2)

Worksheet #12-5—Measurement Performance Criteria Table

Matrix Air

Analytical Group Asbestos

Concentration Level Low

Sampling Procedure[a]	Analytical Method/SOP[b]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
FOP See Worksheet #21	NIOSH 7400 by Phase Contrast Microscopy (PCM)	Completeness	> 90% Laboratory Analysis	Percent Completeness	S & A
		Accuracy/Bias, Contamination	Contamination of sample or extract with a COC	Field blank	S & A

[a]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[b]Reference number from QAPP Worksheet #23 (see Section 3.2)

Worksheet #12-6—Measurement Performance Criteria Table

Matrix Air

Analytical Group TSP

Concentration Level Low

Sampling Procedure[a]	Analytical Method/SOP[b]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
FOP See Worksheet #21	TBD, CRL or subcontracted laboratory	Completeness	> 90% Laboratory Analysis	Percent Completeness	S & A

[a]Reference number from QAPP Worksheet #21 (see Section 3.1.2)
[b]Reference number from QAPP Worksheet #23 (see Section 3.2)

Worksheet #13—Secondary Data Criteria and Limitations Table

(UFP QAPP Manual Section 2.7)

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
PCB, Geotechnical, Total Organic Content, and Asbestos Data	CH2M HILL, Data Evaluation Summary Report, Waukegan Harbor Area of Concern, Waukegan, Illinois, 2005	USEPA	To establish extent of impacted sediment to be remediated	Data collected in January 2005; however, PCB concentrations are persistent in the environment.
PCB Risk Data	CH2M HILL, Risk Evaluation for Development of a PCB Sediment Cleanup Level Waukegan Harbor Area of Concern, July 2006	USEPA	To establish a sediment cleanup level for dredging operations in the harbor	Data was collected in 2003 and 2005; however, PCB concentrations are persistent in the environment.
PCB, Geotechnical, and Asbestos Data	CH2M HILL, Data Evaluation Summary Report, Waukegan Area of Concern, Waukegan, Illinois, 2007)	USEPA	To establish extent and characteristics of impacted sediment to be remediated	Data was collected in November 2006 through March 2007; however, PCB concentrations are persistent in the environment.

Worksheet #14—Summary of Project Tasks

Remedial Action Tasks

Remedial action tasks are described in detail in the basis of design report (CH2M HILL 2010). The following is a summary:

- Construction of the sediment CF on the OMC Plant 2 Site
- Construction of the sediment slurry conditioning and water treatment systems
- Seawall demolition and reconstruction
- Hydraulic dredging of PCB-contaminated sediment and conveyance
- Sediment slurry conditioning and water treatment systems operation
- Treated effluent discharge to the harbor
- CF cover construction
- Residuals management by sand cover placement
- Demolition of piers and docks in the North Marina

The PCB-contaminated sediment will be hydraulically dredged and conveyed through an 8-inch pipeline to the sediment processing systems located on the northern portion of the OMC Plant 2 property (Figure 3). Contaminated sediment in Slip 1 is present in a thin layer (primarily less than 1.5-foot thick) overlaying a dense clay till; therefore, unlike most of the harbor, which will be dredged with a hydraulic cutterhead dredge, the dredging of the Slip 1 sediment down to the till will be conducted using a plain-suction hydraulic dredge.

The hydraulically dredged sediment slurry will be pumped to the CF for dewatering using geotextile tubes. Water generated from the dewatering process will be treated to remove suspended solids and PCBs before being discharged back to the harbor. The water treatment system effluent will be combined with clean harbor water to achieve the acute toxicity criteria for ammonia prior to being pumped to the discharge point in the Entrance Channel.

Upon completion of the dredging, the geotextile tubes within the CF will be isolated from the environment using a clay/soil cover and the sump of the CF will be connected to the water treatment system associated with the existing PCB containment cells to treat future infiltration into the CF. Except for Slip 1, a sand cover will also be placed over dredged harbor segments to manage residual levels of PCBs.

Portions of the North Marina's piers and docks will be removed, as necessary, to allow dredging to occur.

Subcontractor Procurement Tasks

CH2M HILL will solicit, evaluate, select, and award subcontract services to support the completion of the remedial action. Based on the estimated subcontract costs, the major subcontracts (greater than $1 million) include the following:

- **Sediment Processing Systems Construction** will involve constructing the CF and the water treatment plant on the OMC Plant 2 Site.
- **Dredging** will involve hydraulically dredging the approximately 183,000 yd^3 of PCB-contaminated sediment from the harbor and pumping the sediment to the processing system.
- **Sediment Processing Systems Operation** includes supplying the polymer system, dewatering the dredged sediment in the geotextile tubes, operating and maintaining the water treatment plant to treat water generated from the dewatering process, and discharging the treated water back into the harbor.

- **Sediment Processing Systems Demobilization** includes placing a soil cover over the geotextile tubes, decommissioning the water treatment plant, and installing connections to the existing PCB containment cell treatment system.
- **Seawall Reconstruction** will include implementing the City's design to repair the seawall along the Waukegan Coke Plant Site.

The smaller subcontracts (less than $1 million) include the following:

- **North Marina Demolition** involves demolishing the piers to allow removal of sediment from the North Marina.
- **Temporary Facilities** includes procuring utilities, security, constructing the access road to the dredge support area, and other temporary services.
- **Analytical Laboratory Services** will involve analyzing samples (such as air samples) that are not conducted by USEPA's CRL.

Sampling Tasks

Applicable FOPs for project tasks are listed on Worksheet #21 and attached in Appendix B and will be used to support the following primary sampling activities:

- Treatment Plant Effluent Discharge Water Sampling
- Harbor Background Water Sampling
- Harbor Dredging Operations Water Sampling
- Geotextile Tube Dewatering Operations Air Sampling

Analysis Tasks

Laboratory analyses are described in Worksheet #17 (Sampling Design and Rationale). CH2M HILL will arrange for the analysis of environmental samples collected during the field investigation tasks. The following is the analysis and validation:

- Based on the proposed field activities, it is anticipated that water samples will be submitted to an offsite subcontracted laboratory (TBD) or sent to the CRL for standard TAT analyses. Quick-turnaround (72-hour) and special analyses will be subcontracted to an outside laboratory. It will be decided during the procurement process whether samples will be sent to the CRL or a subcontracted laboratory.
- The laboratory analyses will be performed in accordance with the SOPs provided in Appendix C.
- USEPA or its designated contractor will perform the data validation on 100 percent of the chemical results from the CRL laboratory. CH2M HILL will perform the data validation of the subcontract laboratory data. CH2M HILL staff will also process electronic data, perform data completeness and verification, and perform the data evaluation of the field QC results. Prior to validation, unvalidated data may be used to assess ongoing system performance.
- A review of the data validation performed by USEPA will be conducted to assess the quality and defensibility of the data and to check the chain-of-custody forms. The CH2M HILL chemist will review the validated analytical results against the data quality objectives to determine whether the data are acceptable. The CH2M HILL chemist will also review the data validation technical memorandums completed by USEPA and/or their designated contractor. To conduct a holistic review of the data set, additional data evaluation will be performed by subject matter and site experts if necessary.

- Upon completion, the data quality information will be summarized in a data validation report. The report will summarize the data validation findings, including evaluation of field QC samples, as well as provide the USEPA validation reports.

Quality Control Tasks

Implement SOPs. See Worksheets #11, #12, #15, #22, #24, #25, #27, and #28 for items related to QC. QC samples are described on Worksheet #28.

Secondary Data

See QAPP Worksheet #13.

Data Management Tasks

Data management tasks are described in the attached Data Management Plan (Appendix A).

Documentation and Records

Records and field measurements of all samples will be collected in notebooks. Chains of custody, airbills, and sample logs will be prepared and retained for each sample.

A copy of the final UFP QAPP will be kept at the CH2M HILL Milwaukee office.

Assessment/Audit Tasks

See Worksheets #31 and #32.

Worksheet #15-1—Reference Limits and Evaluation Table

Water Treatment Effluent Discharge

Matrix: Water

Analytical Group: PCBs by SW-846 8082

Concentration Level: Low

Analyte	CAS Number	PAL[a] (µg/L)	Project Quantitation Limit (QL) (µg/L)	Achievable Laboratory Limits[b]	
				MDLs (µg/L)	QLs (µg/L)
Aroclor-1221	11104-28-2	N/A	TBD	0.208	TBD
Aroclor-1242	53469-21-9	N/A	TBD	0.155	TBD
Aroclor-1248	12672-29-6	N/A	TBD	0.151	TBD
Aroclor-1254	11097-69-1	N/A	TBD	0.151	TBD
Aroclor-1260	11096-82-5	N/A	TBD	0.152	TBD
Total PCBs	N/A	0.1 or laboratory MDL[c]	N/A	N/A	N/A

[a] The PAL is 0.1 µg/L for Total PCBs. PCB concentrations are reported as total PCBs—the sum of the individual concentrations of the five Aroclors (1221, 1242, 1248, 1254, and 1260) detected in the effluent discharge. Where a mix of detects and nondetects appear for a specific Aroclor, the quantitative value for detected Aroclors will be added to the MDL for each of the nondetected Aroclors. If the Total PCB concentration is not detected, the total PCBs concentration will be represented as the sum of each individual Aroclor's MDL.

[b] QLs and MDLs are laboratory-specific. They will be determined once the laboratory is subcontracted. In order to estimate a reasonable MDL that the laboratory can meet, several laboratories were contacted and submitted their MDLs. The values have been averaged and are entered into this worksheet. Note that the advisory PAL for total PCBs is lower than the individual Aroclor MDLs. Therefore, any detection above the MDL will be considered an exceedance.

[c] The PAL will be considered exceeded if there are any detections above the MDL. In order to determine the appropriate quantitation level for the laboratory, 0.1 µg/L has been selected as an advisory PAL. If there are no detections, the PAL has not been exceeded.

µg/L = microgram per liter

Worksheet #15-2—Reference Limits and Evaluation Table

Water Treatment Effluent Discharge, Harbor Background, Harbor Dredging

Matrix: Water

Analytical Group: General Chemistry

Concentration Level: Medium

Analyte	Analytical Method/ Laboratory	CAS Number	Effluent Discharge and Harbor Dredging PAL[a] (mg/L)	Harbor Background PAL (mg/L)	Project Quantitation Limit (mg/L)	Achievable Laboratory Limits[b]	
						MDLs (mg/L)	QLs (mg/L)
Total Suspended Solids	SM 2540D/ Sub. Laboratory	N/A	15 mg/L above background[c]	N/A—Established for informational purposes	TBD	TBD	TBD
Total Suspended Solids	TBD/ CRL	N/A			TBD	TBD	TBD
Ammonia (Chronic)	SM 4500-NH3/ Sub. Laboratory	7664-41-7	April-October: 0.057 mg/L November-March: 0.025 mg/L		TBD	TBD	TBD

[a] The PAL for TSS is identified in the Basis of Design Report. The PAL for chronic ammonia is from Illinois Administrative Code Title 35, Section 302.535.
[b] QLs and MDLs are laboratory-specific. They will be determined once the laboratory is subcontracted.
[c] Background will be determined by measuring TSS at a location representative of background conditions before dredging activities begin.

Worksheet #15-3—Reference Limits and Evaluation Table

Geotextile Tube Dewatering

Matrix: Ambient Air

Analytical Group: PCBs by USEPA TO-10A

Concentration Level: Low

Analyte	CAS Number	PAL[a] (µg/m^3)	Project Quantitation Limit (µg/m^3)	Achievable Laboratory Limits[b] MDLs (µg/m^3)	Achievable Laboratory Limits[b] QLs (µg/m^3)
Aroclor-1221	11104-28-2	N/A	TBD	TBD	TBD
Aroclor-1242	53469-21-9	N/A	TBD	TBD	TBD
Aroclor-1248	12672-29-6	N/A	TBD	TBD	TBD
Aroclor-1254	11097-69-1	N/A	TBD	TBD	TBD
Aroclor-1260	11096-82-5	N/A	TBD	TBD	TBD
Total PCBs	N/A	TBD[a]	N/A	N/A	N/A

[a] The PAL will be determined after the preconstruction baseline sampling. Samples will be collected during geotextile tube dewatering and compared to baseline results.
[b] QLs and MDLs are laboratory-specific. They will be determined once the laboratory is subcontracted.
µg/m^3 = micrograms per cubic meter

Worksheet #15-4—Reference Limits and Evaluation Table

Geotextile Tube Dewatering

Matrix: Ambient Air

Analytical Group: Asbestos by NIOSH 7400 PCM

Concentration Level: Low

Analyte	CAS Number	PAL[a] (fibers per square millimeter)	Project Quantitation Limit (µg/m^3)	Achievable Laboratory Limits[b] MDLs (µg/m^3)	Achievable Laboratory Limits[b] QLs (µg/m^3)
Asbestos	1332-21-4	TBD[a]	1	TBD	TBD

[a] The PAL will be determined after the pre-construction baseline sampling. Samples will be collected during geotextile tube dewatering and compared to baseline results.

[b] QLs and MDLs are laboratory-specific. They will be determined once the laboratory is subcontracted.

Worksheet #15-5—Reference Limits and Evaluation Table

Geotextile Tube Dewatering
Matrix: Ambient Air
Analytical Group: TSP
Concentration Level: Low

Analyte	CAS Number	PAL[a] (µg/m^3)	Project Quantitation Limit (µg/m^3)	Achievable Laboratory Limits[b]	
				MDLs (µg/m^3)	QLs (µg/m^3)
Total Solid Particulates	N/A	TBD	1	TBD	TBD

[a] The PAL will be determined after the pre-construction baseline sampling. Samples will be collected during geotextile tube dewatering and compared to baseline results.

[b] QLs and MDLs are laboratory-specific. They will be determined once the laboratory is subcontracted.

Worksheet #16—Project Schedule Timeline Table

Task	Expected Completion
Construction Mobilization	March 2012
Seawall Reconstruction	March 2012
North Marina Demolition	Spring 2012
Dredging Operations	August 2012–November 2013
Sediment System Demobilization	July 2014

Worksheet #17—Sampling Design and Rationale

Worksheet #17 describes the field investigation activities planned for the remedial action at Waukegan Harbor. The field activities will be conducted according to the FOPs provided in Appendix B. The number of samples and the analytical parameters planned are summarized in Worksheet #18 (Sampling Locations and Methods/SOP Requirements).

Treatment System Effluent Samples

Treatment system effluent samples will be collected in order to determine whether the discharged water meets the Illinois Administrative Code standards (Worksheet #15). The treatment system is being installed to treat water from sediment dewatering before it is discharged into the harbor. The chosen sampling location is the discharge point located in the entrance channel (Figure 4).

Effluent samples will be analyzed for pH, TSS, total PCBs, and chronic ammonia and compared to the discharge limits as follows:

- pH measurements will be performed onsite using inline instrumentation to continuously collect 24-hour composite samples.
- During the first two weeks of operation for each season, TSS and total PCBs samples will be sent to a subcontracted laboratory daily for quick TAT (72-hour) analysis. It is assumed that 28 samples will be collected overall. After 2 weeks, samples will be collected weekly and sent to the subcontracted laboratory (total PCBs) and CRL (TSS) for analysis for the remainder of dredging and water treatment operations. It is assumed that 66 samples will be collected.
- Additionally, chronic ammonia samples will be collected daily from approximately 500 feet from the discharge pipe in the harbor to verify that chronic standards are being met. The sample will be a composite consisting of water from both the top and bottom thirds of the water column. Temperature and pH will also be collected from this sampling point. A 30-day running average of daily un-ionized ammonia concentrations will be compared to a 30-day running average chronic standard based on actual temperature and pH measurements. Initial background samples will be collected for at least 30 days before dredging startup. Samples will be analyzed by a subcontracted laboratory and reported on a 72-hour TAT. If the standard is exceeded, the dredging in the harbor will be halted until the standard can be achieved.

Water Quality Monitoring Samples

The purpose of the water quality monitoring is to support the protection of human health and the environment during dredging operations.

Background Samples

Water quality monitoring activities include establishing conditions in the harbor prior to dredging by collecting background samples. The background readings will form the basis of comparison for the monitoring data. The measurements will be taken at locations representative of background conditions given the impacts industrial and commercial ship traffic have on water quality. The background harbor monitoring consists of the following activities:

- Background measurements of turbidity and TSS will be taken before dredging begins at locations representative of background conditions given the effects industrial and commercial ship traffic have on water quality. Samples for TSS will be collected daily over a 2-week period before each dredge season (28 samples) with the results being reported on a 72-hour TAT by a subcontracted laboratory.
- Background samples for ammonia will be collected at the entrance of the harbor about 500 feet from the discharge point. The samples will be collected daily over a 30-day period to establish the 30-day average

before each dredge season begins (60 samples). The samples will also be reported on a 72-hour TAT by a subcontracted laboratory.

Harbor Monitoring During Dredging Samples

Water quality monitoring during dredging consists of the following:

- Turbidity readings will be collected in real time on a daily basis using a backscatter nephelometer with an underwater sensor and direct surface readout. Turbidity will be measured at a monitoring point at the mouth of the harbor on the lake side of the turbidity controls and reported weekly. The underwater sensor will be installed at one-half the water depth and will collect data on a continuous basis for assessing turbidity levels.
- TSS grab samples will be collected in vicinity of the turbidity monitoring location. The samples will be analyzed with result reported on a 72-hour TAT by a subcontracted laboratory. The samples will be collected daily for the first 2 weeks of each dredge season (28 samples) to establish the correlation between TSS and turbidity. Once the correlation is established, the frequency of TSS measurement will be reduced to weekly (55 samples) with results reported with a standard TAT by CRL.
- Ammonia samples will be collected daily (540 samples) and sent to a subcontracted laboratory for 72-hour TAT analysis.

Based on experience on other dredging projects, it is anticipated that the correlation between TSS and turbidity is nearly 1 mg/L to 1 nephelometric turbidity unit. Therefore, the upper level criterion will be 15 nephelometric turbidity units above background. Ship traffic through the harbor disturbs the sediment with the use of the prop and thrusters, resulting in temporary turbidity and TSS increases; therefore, the upper level criterion will not be applicable during time of ship traffic.

When the upper level criterion is being approached or has been exceeded due to project activities, dredging will be halted temporarily until turbidity levels decrease below the criterion. During this time, the dredging subcontractor shall notify the CM, project quality manager, and SM who will in turn notify the USEPA representative and attempt to identify and rectify the cause of the exceedance. The monitoring will then resume at the start of dredging at an increased level of frequency to verify that turbid conditions have abated. Explanatory details will be made on an accompanying data reporting sheet documenting the exceedance and corrective measures taken.

Air Monitoring Samples

Air monitoring will be conducted to document PCBs, asbestos, and TSP levels during the initiation of dewatering operations. Locations for monitoring will be selected at four locations around the site and samples will be collected to be analyzed for PCBs, asbestos, and TSP. PCBs and asbestos samples will be sent to a subcontracted laboratory. TSP will be sent to the CRL. Samples will be collected before initiation of construction activities to establish baseline condition and during the first month of operations to verify the engineering controls to minimize dust are being implemented appropriately. The PAL will be determined after the preconstruction baseline sampling. Samples collected during geotextile tube dewatering will be compared to baseline results.

Worksheet #18—Sampling Locations and Methods/ SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples (+ FDs)	Sampling SOP Reference[a]	Rationale for Sampling Location
Treatment System Effluent Discharge Samples	Water	N/A	PCBs, TSS	Low, Medium	72-hour TAT daily samples (first 2 weeks of each season): April–October: 14 (+2) November–March: 14 (+2)	FOP #2	See Worksheet #17
					Standard TAT weekly samples: 66 (+7)	FOP #2	
		Composite of water from top and bottom thirds of water column	Chronic ammonia	Medium	TBD, daily samples until treatment system is no longer in use	FOP #2	
		N/A	pH	Medium		FOP #2	
Water Quality Monitoring-Background Samples	Water	N/A	TSS	Medium	72-hour TAT daily samples (first two weeks of each season): April–October: 14 (+2) November–March: 14 (+2)	FOP #1	
			Ammonia	Medium	72-hour TAT daily samples (first 30 days of each season): April–October: 30 (+3) November–March: 30 (+3)	FOP #1	
Water Quality Monitoring-Harbor Monitoring During Dredging Samples	Water	One-half the water depth	Turbidity	Medium	TBD, Continuous daily samples throughout dredging operations	FOP #8	

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples (+ FDs)	Sampling SOP Reference[a]	Rationale for Sampling Location
		N/A	TSS	Medium	72-hour TAT daily samples (first 2 weeks of each season): April–October: 14 (+2) November–March: 14 (+2)	FOP #1	
					Standard TAT weekly samples: 55 (+6)	FOP #1	
			Ammonia	Medium	Daily samples throughout dredging operations: 540 (+54)	FOP #1	
Air Monitoring Samples	Ambient Air	N/A	PCBs, Asbestos, TSP	Low	4 locations will be samples 5 times (Once as a baseline then weekly for the first month) 20 total samples	FOP #7, TBD	

[a]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #21).

Worksheet #19—Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[a]	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Water	PCBs	Low	SW-846 8082/ TBD[b]	Two 1-liter amber bottles	4 ± 2°C	Extraction: 7 days from sample collection; Analysis: 40 days after completion of extraction
	TSS	Medium	CRL or subcontracted laboratory SOP/ TBD[b]	TBD[b]	TBD[2]	TBD[b]
			SM 2540D	TBD[b]	4 ± 2°C	7 days
	Ammonia	Medium	SM 4500-NH3/ TBD[b]	TBD[b]	H_2SO_4 to a pH <2, 4 ± 2°C	28 days
Air	PCBs	Low	EPA TO-10A/ TBD[b]	Sorbent cartridge containing polyurethane foam	< 4°C	Extraction: 7 days from sample collection; Analysis: 40 days after completion of extraction
	Asbestos	Low	NIOSH 7400 PCM/TBD[b]	0.45- to 1.2-micron cellulose ester membrane filter	None	None
	TSP	Low	CRL or subcontracted laboratory SOP/ TBD[b]	TBD[b]	TBD[b]	TBD[b]

[a] SOP references are from the Analytical SOP References table (Worksheet #23).
[b] "TBD" information is laboratory-specific and will be provided when the laboratories have been identified.

Worksheet #20—Field Quality Control Sample Summary Table

Field Duplicate Samples

FDs are two field samples taken at the same time in the same location. They are intended to represent the same population and are taken through all steps of the sampling and analytical procedures in the same manner as the associated native sample. The samples are used to assess the precision of the entire data collection activity, including sampling, sample handling and storage, and site heterogeneity. The FDs may be either colocated or replicates of a single sampling collection. An example of a colocated sample is a side by side core sample, while replicates are taken from the same boring core. The FDs are assigned a unique sample name and are collected in a separate container from the associated native sample. One FD will be collected for every 10 field samples.

Matrix Spike/Matrix Spike Duplicate Samples

MS/MSD samples are an aliquot of the sample spiked with known concentrations of specific analytes. The spiking occurs before sample preparation and analysis at the laboratory. Samples will be collected in triplicate and the additional volume used for MS/MSD analysis. An MS/MSD pair will be collected for every 20 field samples.

Field Blanks

Field blanks are collected in ambient conditions in order to monitor potential contamination due to site conditions. Field blanks will be collected for PCBs and asbestos in air samples only.

Worksheet #20—Field Quality Control Sample Summary Table (continued)

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference[a]	No. of Sampling Locations[b]	No. of FDs	No. of MS/ MSDs	No. of Field Blanks	Total No. of Samples to Laboratory[b]
Treatment System Effluent Discharge Samples								
Water	PCBs by SW-846 8082	Low	See Worksheet #23	94	10	6/6	0	TBD
	TSS by SM2540D	Medium		28	4	0	0	TBD
	TSS by CRL or subcontracted laboratory	Medium		66	7	0	0	TBD
	Ammonia	Medium		TBD/ Daily	TBD	TBD	0	TBD
Water Quality Monitoring—Background Samples								
Water	TSS by SM2540D	Medium	See Worksheet #23	28	4	0	0	TBD
	Ammonia	Medium		60	6	4/4	0	TBD
Water Quality Monitoring—Harbor Monitoring During Dredging Samples								
Water	TSS by SM2540D	Medium	See Worksheet #23	28	4	0	0	TBD
	TSS by CRL or subcontracted laboratory	Medium		55	6	0		TBD
	Ammonia	Medium		540	54	30/30		TBD
Air Quality Monitoring—Geotextile Tube Dewatering								
Air	PCBs by TO-10A	Low	See Worksheet #23	20	0	0	1/ sample shipment	TBD
	Asbestos	Low		20	0	0	1/ sample shipment	TBD
	TSP	Low		20	0	0	0	TBD

[a] See Worksheet #23 and Appendix C

[b] Subject to change due to field conditions

Worksheet #21—Project Sampling FOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
FOP #1	Surface Water Sample Collection	CH2M HILL	Water quality meter	☐	
FOP #2	Treatment System Effluent Sampling	CH2M HILL	Sample bottles	☐	
FOP #3	Sample Handling, Packaging, and Shipment	CH2M HILL	Procedural guidance	☐	
FOP #4	Documentation and Chain-of-Custody Procedures	CH2M HILL	Procedural guidance	☐	
FOP #5	Field Logbook	CH2M HILL	Procedural guidance	☐	
FOP #6	Decontamination of Equipment and Personnel	CH2M HILL	Procedural guidance	☐	
FOP #7	High-volume TSP Matter Sampling	CH2M HILL	High-volume TSP sampler	☐	
FOP #8	Turbidity Measurement by Portable Meter	CH2M HILL	Turbidity meter	☐	
FOP #9 (TBD)	Air Monitoring—to be performed by subcontractor. Once subcontractor is identified, their FOP will be included in this QAPP	Subcontractor, TBD	TBD	☐	

Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Turbidity meter	Calibrate with standards	Model-specific, per manufacturer's recommendation	Turbidity	Daily	Model-specific, per manufacturer's recommendation	See Equipment Specific Operation Manual	FTL	Model and manufacturer specific
High volume air sampler	Calibrate with standards	Model specific, per manufacturer's recommendation	TSP	Weekly	Model-specific, per manufacturer's recommendation	See Equipment Specific Operation Manual	FTL	Model and manufacturer specific
Personal air monitoring pump (TSI Model SP350)		Model specific, per manufacturer's recommendation	Asbestos, PCBs	Weekly	Model-specific, per manufacturer's recommendation	See Equipment Specific Operation Manual	FTL	Model and manufacturer specific

Worksheet #23—Analytical SOP References Table

The analytical SOP reference numbers below are the method references for the analyses performed by the subcontract laboratory. For all other analyses, the laboratory SOP is referenced. Appendix C of this UFP QAPP includes these methods. Note that the methods have not been modified specifically for this project and may not reflect the exact requirements of this QAPP. The actual laboratory SOPs will be followed and supplemented by internal communication systems within the laboratory to disseminate the project requirements to technical staff.

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
SW-846 8082A	Method 8082A PCBs by Gas Chromatography, Revision 1, February 2007.	Definitive	PCBs	GC/ECD	Subcontracted Laboratory-TBD	N
SM 2540D	Standard Methods for the Examination of Water and Wastewater, Method 2540 D. Total Suspended Solids Dried at 103–105°C.	Definitive	TSS	N/A	Subcontracted Laboratory-TBD	N
CRLSOP: AIG018	Analysis of Residue, Non-Filterable (Total Suspended Solids) in Water, Standard Method 2540D (Gravimetric, 103°C to 105°C), Revision 3.6, October 2011.	Definitive	TSS	N/A	CRL	N
SM 4500-NH3	Standard Methods for the Examination of Water and Wastewater, Method 4500-NH3. Nitrogen (Ammonia).	Definitive	Ammonia	N/A	Subcontracted Laboratory-TBD	N
TO-10A	Compendium Method TO-10A, Determination of pesticides and Polychlorinated Biphenyls In Ambient Air using Low Volume Polyurethane Foam (PUF) Sampling followed by Gas Chromatographic/Multi-Detector Detection (GC/MD), January 1999.	Definitive	PCBs	GC/ECD	Subcontracted Laboratory-TBD	N
NIOSH 7400	Asbestos and Other Fibers by PCM, Method 7400, Issue 2, August 1994.	Definitive	Asbestos	PCM	Subcontracted Laboratory-TBD	N
CRLSOP: AIG047	Analysis of Particulate Matter as PM10 and PM2.5 in Atmosphere (High Volume Sampler), Revision 3.1, February 2011.	Definitive	TPS	N/A	CRL	N

Note:

GC/ECD = gas chromatography/electron capture detector

Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference[a]
GC/ECD (SW846 8082A)	Initial Calibration	Before beginning a sample run or whenever the laboratory takes corrective action which may change the initial calibration (example-column replacement)	RSD from SW-846 8082A/ Laboratory SOP	Inspect system for problems, correct problem, recalibrate	Laboratory Analyst	SW-846 8082A
	Continuing Calibration Verification	Once every 12 hours	% D from SW-846 8082A/ Laboratory SOP	Inspect system for problems, correct problems, recalibrate, reanalyze samples		
GC/MS (TO-10A)	Initial Calibration	Prior to sample analysis and major instrument maintenance	RSD from TO-10A/ Laboratory SOP	Inspect system for problems, correct problem, recalibrate	Laboratory Analyst	TO-10A
	Continuing Calibration Verification	Once every 12 hours	% D from TO-10A/ Laboratory SOP	Inspect system for problems, correct problems, recalibrate, reanalyze samples		
NIOSH 7400	Calibration	Daily	A test slide contains seven blocks of grooves (ca. 20 grooves per block) in descending order of visibility. For asbestos counting, the microscope optics must completely resolve the grooved lines in block 3 although they may appear somewhat faint, and the grooved lines in blocks 6 and 7 must be invisible when centered in the graticule area. Blocks 4 and 5 must be at least partially visible but may vary slightly in visibility between microscopes. A microscope which fails to meet these requirements has resolution either too low or too high for fiber counting.	If image quality deteriorates, clean the microscope optics. If the problem persists, consult the microscope manufacturer.	Laboratory Analyst	NIOSH 7400

[a]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).
GC/MS = gas chromatograph/mass spectrometer; RSD = relative standard deviation

Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

The CRL and contract laboratory will keep all maintenance, testing, and inspection records on file at the laboratory.

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[a]
GC/ECD	Replace septa, replace inlet liner, clip column, bake out detectors, recondition column.	PCBs	Check connections, replace disposables, bake out instrument, recondition column and perform leak checks.	Replace liner, septa, and clip column as indicated by instrument change in response and chromatography. Bake out detectors and columns if signal elevated.	See Worksheet #24	Inspect system; correct problem; perform new initial calibration and affected samples.	Analyst/ Supervisor	SW-846 8082

[a]Specify the appropriate reference letter or number from Analytical SOP References Table (Worksheet #23).

Worksheet #26—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT

Sample Collection (Personnel/Organization): FTL/CH2M HILL

Sample Packaging (Personnel/Organization): FTL/CH2M HILL

Coordination of Shipment (Personnel/Organization): FTL/CH2M HILL

Type of Shipment/Carrier: Fed Ex Overnight or Courier

SAMPLE RECEIPT AND ANALYSIS

Sample Receipt (Personnel/Organization): CRL, Subcontracted Laboratory

Sample Custody and Storage (Personnel/Organization): CRL, Subcontracted Laboratory

Sample Preparation (Personnel/Organization): CRL, Subcontracted Laboratory

Sample Determinative Analysis (Personnel/Organization): CRL, Subcontracted Laboratory

SAMPLE ARCHIVING

Field Sample Storage (No. of days from sample collection): See QAPP Worksheet #19 for required holding time

Sample Extract/Digestate Storage (No. of days from extraction/digestion): See QAPP Worksheet #19 for required holding time

Biological Sample Storage (No. of days from sample collection): N/A

SAMPLE DISPOSAL

Personnel/Organization: CRL, Subcontracted Laboratory

Number of Days from Analysis: TBD by CRL, Subcontracted Laboratory

Worksheet #27—Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory)

Sample handling, packaging, and shipment will be performed per and FOP #3 Sample Handling, Packaging, and Shipment and FOP #4 Documentation/Chain-of-Custody Procedures.

Sample coolers will be shipped to arrive at the CRL, or subcontracted laboratory the morning after sampling (priority overnight) or will be sent by a courier to arrive the same day.

Regulations for packaging, marking/labeling, and shipping of hazardous materials and wastes are promulgated by the U.S. Department of Transportation. Air carriers that transport hazardous materials, in particular Federal Express, require compliance with the current edition of the International Air Transport Association Dangerous Goods Regulations, which applies to shipment and transportation of hazardous materials by air carrier. Following current International Air Transport Association regulations will ensure compliance with the U.S. Department of Transportation.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal)

Upon sample receipt, the laboratory sample custodian will verify package seals, open the packages, check temperature blanks, record temperatures, verify sample integrity, and inspect contents against chain-of-custody forms. The laboratory project manager will be contacted to seek resolution of any discrepancies between sample containers and chain-of-custody forms through contract-defined channels of communication. Once the shipment and chain-of-custody form are in agreement, the sample custodian will initiate an internal chain-of-custody form, as well as supply the laboratory task manager with a sample acknowledgement letter. When applicable, sample preservation will be checked and pH documented. If the sample temperatures are outside the required range, the laboratory will contact the project manager or the contractor as to the proper course of action.

Samples will be logged in and assigned a unique laboratory number for each sample. This number will be used by all laboratory personnel handling samples to ensure all sample information is captured. Analyses required will be specified by codes assigned to samples at login. Labels containing the laboratory sample number are generated and placed on sample bottles.

After the laboratory labels the samples, they will be moved to refrigerators where they will be maintained at 4 ± 2ºC.

When the analyst is ready to prep and/or analyze the sample(s), an appropriate member of the sample management department will locate the sample(s) in the locked refrigerator, sign and date the internal sample tracking form, and provide the sample(s) to the analyst. When the analyst is finished with sample(s), unused portions will be returned to an appropriate member of the sample management department for replacement in a secure refrigerator. The analyst will sign and date internal chain-of-custody forms. In the event that entire samples are depleted during analysis, a notation of "sample depleted" or "entire sample used" will be written on the internal chain-of-custody forms.

Samples will be stored in designated secure, refrigerated storage areas. Samples and sample extracts will be maintained in a secure storage until disposal. No samples or extracts will be disposed of without prior written approval from an appropriate member of the project team. The sample custodian will note the sample disposal date in the sample ledger. The laboratory will dispose of samples in accordance with applicable regulations.

Documentation will be placed in a single, secured project file, maintained by the laboratory project manager. This file will consist of these components: agreements, correspondence, memorandums, notes, and data.

Reports (including QA reports) will be filed with correspondence. Analytical laboratory documentation, field data, and notes will be filed with the laboratory data. Filed materials may only be removed by authorized personnel on

a temporary basis. The name of the person removing the file will be recorded. Laboratories will retain project files and data packages for a minimum of 7 years, unless otherwise agreed.

Sample Identification Procedures

A sample numbering system will be used to identify each sample, including duplicate and blank samples. The sample number will be a unique identifier.

Each sample, regardless of analytical protocol, will also be assigned a CH2M HILL site-specific identifier, which will contain a site- and sample-specific location identifier that indicates where the sample was obtained.

The sample number and station location identifier will be included on the sample tag, the traffic report and the chain-of-custody record.

The site-specific identifier is based on the following system:

- **Site**—WH
- **Station Location**—The station location identifier is the unique name of the sampling location. The location name will vary depending on the reason for sampling and the numeric location number assigned to that location.

The first letters indicate the type of sample location:

- **DW**—Discharge Water
- **HWB**—Harbor Water (Background)
- **HW**—Harbor Water
- **AA**—Ambient Air near sediment dewatering operations
- The three number location codes are sequentially generated based upon the order that the sampling is performed. Location codes will start with the 001 series (for example, 001, 002, etc.).
- **QC Samples**—FDs will have an "R" appended to the end of the station location identifier. MS/MSDs are not identified in the station location identifier, but on the tag and the chain-of-custody form. Field blank identifiers are "FB." QC samples will be sequentially numbered, and a record of those assigned will be kept in the field log book.
- **Date Indicator**—The sample date will be appended to the station location and consist of a hyphen followed by "MMDDYY," which will refer to the month, day, and year that the sample was collected. This will be helpful because many samples will be collected daily or weekly to monitor the harbor conditions.

Example

- WA-HW010-070112 is a harbor water sample collected at location 010 on July 1, 2012.

Chain-of-Custody Procedures

Chains of custody will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information as per the FOP. Sample information will include sample identification, date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain of custody will also have the sampler's name and signature. The chain of custody will link location of the sample from the field logbook through sample disposal by the laboratory. The laboratory will use the sample information to populate the laboratory database for each sample.

Worksheet #28-1—QC Samples Table

This worksheet provides information on the analytical QC requirements relevant to the analysis of environmental samples. The purpose of the laboratory QC activities is to produce data of known quality that satisfy the project-specific data quality objectives. Worksheet #24 (Analytical Instrument Calibration) and the methods included in Appendix C provide additional QA/QC requirements.

Matrix: Water
Analytical Group: PCBs
Analytical Method/SOP Reference: SW-846 8082A

QC Sample	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
MB	1/Extraction Batch	All analytes < MDL	Correct problem, then reprep and analyze MB and all samples processed with the contaminated blank.	Laboratory analyst	Accuracy/ Bias
MS/MSD	1/Extraction Batch	Recovery within limits stated in method and/or laboratory SOP	If the MS and/or MSD are outside of either accuracy or precision tolerances flag MS/MSD results.	Laboratory analyst	Accuracy/ Bias
LCS	1/Extraction Batch	Recovery within limits stated in method and/or laboratory SOP	Correct problem then reprepare and analyze the LCS and all samples in the affected analytical batch.	Laboratory analyst	Sensitivity
Surrogate Spike (organics)	Every sample, spiked sample, standard, and MB	Recovery within limits stated in method	Correct the problem and reanalyze sample.	Laboratory analyst	Accuracy/ Bias

Worksheet #28-2—QC Samples Table

Matrix: Water

Analytical Group: TSS

Analytical Method/SOP Reference: SM 2540D

QC Sample:	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Laboratory Duplicate	1/Extraction Batch	Recovery within limits stated in method and/or laboratory SOP	PC will evaluate results for possible source of variability; notify data users.	Laboratory analyst	Precision

Worksheet #28-3—QC Samples Table

Matrix: Water

Analytical Group: TSS

Analytical Method/SOP Reference: CRLSOP: AIG018

QC Sample	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Laboratory Duplicate	1/Extraction Batch	RPD ≤ 20%	PC will evaluate results for possible source of variability; notify data users.	Laboratory analyst	Precision
Laboratory Reagent Blank	1/Extraction Batch	0 ± 5 mg/L.	Verify that there is no contamination. Use fresh clean glassware. Verify that the laboratory water is of good quality.	Laboratory analyst	Accuracy/Bias

Worksheet #28-4—QC Samples Table

Matrix: Water

Analytical Group: Ammonia

Analytical Method/SOP Reference: SM 4500 NH3

QC Sample:	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
MB	1/Extraction Batch	All analytes < RL	Correct problem, then reprep and analyze MB and all samples processed with the contaminated blank.	Laboratory analyst	Accuracy/Bias
MS/MSD	1/Extraction Batch	Recovery within limits stated in method and/or Laboratory SOP	If the MS and/or MSD are outside of either accuracy or precision tolerances flag MS/MSD results.	Laboratory analyst	Accuracy/Bias
Laboratory Duplicate	1/Extraction Batch	Recovery within limits stated in method and/or Laboratory SOP	PC will evaluate results for possible source of variability; notify data users.	Laboratory analyst	Precision
LCS	1/Extraction Batch	Recovery within limits stated in method and/or Laboratory SOP	Correct problem then reprepare and analyze the LCS and all samples in the affected analytical batch.	Laboratory analyst	Sensitivity

Worksheet #28-5—QC Samples Table

Matrix: Air

Analytical Group: PCBs

Analytical Method/SOP Reference: EPA TO-10A

QC Sample:	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Process Blank	1/Extraction Batch	Blank levels < 100 ng/sample	Correct problem, then reprep and analyze MB and all samples processed with the contaminated blank.	Laboratory analyst	Accuracy/Bias
MS/MSD	1/Extraction Batch	Recovery within limits stated in method and/or laboratory SOP	If the MS and/or MSD are outside of either accuracy or precision tolerances flag MS/MSD results.	Laboratory analyst	Accuracy/Bias
Solvent Process Blank	1/Extraction Batch	Blank levels < 100 ng/sample	Correct problem, then reprep and analyze MB and all samples processed with the contaminated blank.	Laboratory analyst	Accuracy/Bias
FB	1/Extraction Batch	Blank levels < 100 ng/sample	Correct problem, then reprep and analyze MB and all samples processed with the contaminated blank.	Laboratory analyst	Accuracy/Bias

Worksheet #28-6—QC Samples Table

Matrix: Air

Analytical Group: Asbestos

Analytical Method/SOP Reference: NIOSH 7400

QC Sample:	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Blind recounts	10% of filters counted	Recovery within limits stated in method and/or laboratory SOP	If a pair of counts is rejected by this test, recount the remaining samples in the set and test the new counts against the first counts. Discard all rejected paired counts.	Laboratory analyst	Bias

Worksheet #28-7—QC Samples Table

Matrix: Air

Analytical Group: TSP

Analytical Method/SOP Reference: CRL SOP: AIG047

QC Sample:	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Tare weight check	1 per sample batch; prior to sample analysis	Recovery within limits stated in method and/or laboratory SOP	Notify group leader and evaluate options	Laboratory analyst	Accuracy/Bias
Gross weight check	1 per sample batch; prior to sample analysis	Recovery within limits stated in method and/or laboratory SOP	Notify group leader and evaluate options	Laboratory analyst	Accuracy/Bias

Worksheet #29—Project Documents and Records Table

Sample Collection Documents and Records	Onsite Analysis Documents and Records	Offsite Analysis Documents and Records	Data Assessment Documents and Records	Other
Field Notes Chain-of-Custody Records Air Bills Custody Seals Telephone Logs Corrective Action Forms	Field log books Task-specific sampling logs (e.g., field parameter log sheets, soil boring logs, calibration logs)—may be included in field log books.	Sample Receipt, Custody, and Tracking Records Standard Traceability Logs Equipment Calibration Logs Sample Prep Logs Run Logs Equipment Maintenance, Testing, and Inspection Logs Corrective Action Forms Reported Field Sample Results Reported Results for Standards, QC Checks, and QC Samples Instrument Printout (raw data) for Field Samples, Standards, QC Checks, and QC Samples Data Package Completeness Checklists Sample Disposal Records Telephone Logs Extraction/Cleanup Records Raw Data (stored on disk or CD-R) QA Review Records Hard Copy Report	Data Validation Reports Corrective Action Forms Telephone Logs	

Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name, Address, Contact Person, and Telephone Number)	Backup Laboratory/Organization (Name, Address, Contact Person, and Telephone Number)
Treatment System Effluent Discharge Samples							
Water	PCBs	Low	See Worksheets #18 and 27	SW-846 8082A	72-hour TAT for Form 1 results; Full package—21 calendar days	Subcontracted Laboratory—TBD	
	TSS	Medium		SM2540D	72-hour TAT for Form 1 results; Full package—21 calendar days	Subcontracted Laboratory—TBD	
	TSS	Medium		CRLSOP: AIG018	Full package—21 calendar days	USEPA Region 5 Chicago Regional Laboratory 536 S. Clark St., ML-10C Chicago, IL 60605 (312) 353-0375 Amanda Wroble	
	Ammonia	Medium		SM 4500 NH3	72-hour TAT for Form 1 results; Full package—21 calendar days	Subcontracted Laboratory—TBD	
Water Quality Monitoring—Background Samples							
Water	TSS by SM2540D	Medium	See Worksheets #18 and 27	SM2540D	72-hour TAT for Form 1 results; Full package—21 calendar days	Subcontracted Laboratory—TBD	
	Ammonia	Medium		SM 4500 NH3	72-hour TAT for Form 1 results; Full package—21 calendar days	Subcontracted Laboratory—TBD	

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization (Name, Address, Contact Person, and Telephone Number)	Backup Laboratory/Organization (Name, Address, Contact Person, and Telephone Number)
Water Quality Monitoring—Harbor Monitoring During Dredging Samples							
Water	TSS by SM2540D	Medium	See Worksheets #18 and 27	SM2540D	72-hour TAT for Form 1 results; Full package—21 calendar days	Subcontracted Laboratory—TBD	
	TSS by CRL	Medium		CRLSOP: AIG018	Full package—21 calendar days	CRL	
	Ammonia	Medium		SM 4500 NH3	72-hour TAT for Form 1 results; Full package—21 calendar days	Subcontracted Laboratory—TBD	
Air Monitoring—Geotextile Tube Dewatering							
Air	PCBs by TO-10A	Low	See Worksheet #18, 27	TO-10A	Full package—21 calendar days	Subcontracted Laboratory—TBD	
	Asbestos	Low		NIOSH 7400	Full package—21 calendar days	Subcontracted Laboratory—TBD	
	TSP	Low		CRLSOP: AIG047	Full package—21 calendar days	CRL	

Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Action (Title and Organizational Affiliation)
Construction Quality Audit	Once per definable feature of work	Internal	CH2M HILL	Dan MacGregor and / or Theresa Rojas, CH2M HILL	Jeff Lamont/CM/ CH2M HILL	Jeff Lamont/CM/CH2M HILL	Dan MacGregor/Project Quality Manager/ CH2M HILL
Health and Safety Audit	Once per definable feature of work	Internal	CH2M HILL	Mark Orman, Health and Safety Manager, CH2M HILL	Jeff Lamont, CM, CH2M HILL	Jeff Lamont, CM, CH2M HILL	Mark Orman, Health and Safety Manager, CH2M HILL
Project Performance Audit	Monthly	Internal	CH2M HILL	Denis Ewing/ PDL/CH2M HILL	Jewelle Keiser/SM/ CH2M HILL	Jewelle Keiser/SM/CH2M HILL	Denis Ewing/ PDL/CH2M HILL
Environmental Audit	Annually	Internal	CH2M HILL	Terri Gerrish/Environmental Manager/CH2M HILL	Jeff Lamont, CM, CH2M HILL	Jeff Lamont, CM, CH2M HILL	Terri Gerrish/ Environmental Manager/ CH2M HILL
Punch List Inspection	Near the completion of work for each property	Internal	CH2M HILL	Jeff Lamont, CM, CH2M HILL	Resident Inspectors and Subcontractors, TBD	Jeff Lamont, CM, CH2M HILL	Jeff Lamont, CM, CH2M HILL
Prefinal Inspection	Before client inspection	Internal	CH2M HILL	Dan MacGregor, Project Quality Manager, CH2M HILL	Jeff Lamont, CM, CH2M HILL	Dan MacGregor, Project Quality Manager/CH2M HILL	Dan MacGregor, Project Quality Manager, CH2M HILL
Final Client Inspection	Upon completion of work	External	USEPA	TBD, USEPA	Jeff Lamont, CM, CH2M HILL Dan MacGregor, Project Quality Manager, CH2M HILL Jewelle Keiser, SM, CH2M HILL	Jeff Lamont, CM, CH2M HILL Dan MacGregor, Project Quality Manager, CH2M HILL Jewelle Keiser, SM, CH2M HILL	Jeff Lamont, CM, CH2M HILL Dan MacGregor, Project Quality Manager, CH2M HILL Jewelle Keiser, SM, CH2M HILL

Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
All	Nonconformance Report	Jeff Lamont, CM, CH2M HILL TBD, subcontractor Dan MacGregor, Project Quality Manager, CH2M HILL Jewelle Keiser, SM, CH2M HILL	As soon as possible	Acceptance portion of Nonconformance Report	Jeff Lamont, CM, CH2M HILL Dan MacGregor, Project Quality Manager, CH2M HILL Jewelle Keiser, SM, CH2M HILL	As soon as possible

Worksheet #33—QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Daily Field Progress Report	Daily, by e-mail	Daily	Resident Inspectors, CH2M HILL	CM and Project Quality Manager, CH2M HILL
Weekly Notification of Daily Progress Reports on Sharepoint	Weekly notification	After end of week	Document Manager, CH2M HILL	All project team members
Monthly Progress Report	Monthly, by SharePoint	After current month ends	Jewelle Keiser, SM, CH2M HILL	All project team members
Data Quality Evaluation	1 after all data are validated	60 days after project completion	Megan Morrison, PC, CH2M HILL	Jewelle Keiser, SM, CH2M HILL
Final Project Report	1 after project completion	60 days after project completion	Jewelle Keiser, SM, CH2M HILL	Tim Drexler, Remedial Project Manager, USEPA

Worksheet #34—Verification (Step I) Process Table

To ensure that scientifically sound data of known and documented quality are used in making environmental decisions, the following three-step data review will be performed: Step I (verification) will confirm that the sampling and analytical requirements have been met. Step II (validation) will assess whether the sampling and analytical processes comply with the contract-specific and the QAPP-specific requirements. Step III (usability assessment) will determine whether the resulting data are suitable as a basis for the decision being made. Worksheets #34 through #37 describe the processes to be followed. Worksheet #34 establishes the procedures that will be followed to verify project data including, but not limited to, sampling documents and analytical data package.

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Field Notes	Field notes will be reviewed internally and placed in the site file. A copy of the field notes will be attached to the final report.	Internal	FTL
Chain-of-Custody and Shipping Forms	Chain-of-custody and shipping forms will be reviewed internally upon their completion and verified against the packed coolers they represent. The shippers' signature on the chain of custody should be initialed by the reviewer, a copy of the chain of custody retained in the site file, and the original and remaining copies taped inside the cooler for shipment.	Internal	FTL
Laboratory Data	All laboratory data packages will be verified externally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received data packages from the Contract Laboratory Program will be verified externally according to the data validation procedures specified in USEPA *National Functional Guidelines for Organic Data Validation (2008).*	External and internal	Subcontracted Laboratory, CRL, and CH2M HILL

Worksheet #35—Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	SOPs	Ensure all sampling SOPs were followed.	FTL
IIa	SOPs	Ensure all analytical SOPs were followed.	USEPA
IIa	Documentation of method QC results	Establish that all method-required QC samples were analyzed and met the required limits.	Megan Morrison, CH2M HILL, USEPA Validation Contractor
IIb	Onsite field data	All onsite field data will be reviewed against QAPP requirements for completeness and accuracy based on the field calibration records.	FTL
IIb	Documentation of QAPP QC sample results	Establish that all QAPP required QC samples were run and met required limits.	Megan Morrison, CH2M HILL, USEPA Validation Contractor
IIb	Project quantitation limits	Verify that all sample results met the project quantitation limit specified in the QAPP.	Megan Morrison, CH2M HILL

Worksheet #36—Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa/IIb	Water	PCBs, TSS, Ammonia	Low	USEPA National Functional Guidelines, laboratory SOPs, and/or QAPP criteria as appropriate	USEPA or CH2M HILL
IIa/IIb	Air	PCBs, Asbestos, TSP	Low	USEPA National Functional Guidelines, laboratory SOPs, and/or QAPP criteria as appropriate	USEPA or CH2M HILL

Worksheet #37—Usability Assessment

The data usability assessment is an evaluation based on the results of data verification and validation in the context of the overall project decisions or objectives. The assessment determines whether project execution and resulting data meet the project data quality objectives. Both the sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

The following sections summarize the processes to determine whether the collected data are of the right type, quality, and quantity to support the environmental decision making for the project, and describes how data quality issues will be addressed and how limitations of the use of the data will be handled.

Summary of Usability Assessment Processes

It is the responsibility of the PC and the laboratory to ensure that the data meet the method detection limits, reporting limits, and laboratory QC limits listed in this QAPP. During the data verification assessment, non-conformances are documented and data are qualified for use in decision making. The data are determined to be usable by the PC based on the requirements of this QAPP. All data are usable as qualified by the data validator, with the exception of rejected data. Estimated and/or biased results are usable. Outliers, if present, can be addressed on a case-by-case basis. There is no generic formula for determining whether a result is an outlier. Potential outliers will be referred to a statistician and senior consultant, who will determine which formulas are appropriate for classifying data points in a statistically appropriate and defendable manner.

Evaluation Procedures to Assess Project-specific Overall Measurement Error

In-depth assessment occurs during the data verification process. The verification will assess conformance with the requirements of the methods, SOPs and objectives of this QAPP. The findings of the data verification process will generate qualifiers applied to the data considered in context to assess overall usability of the data.

Usability Assessment Documentation

The data verification report will identify precision and accuracy exceedances with respect to the laboratory performance for each batch of samples, as well as comparability of field and laboratory duplicates. All the results will be assembled and statistically reported for an overall quality assessment provided in the final project event report. Discussion will cover precision, accuracy, representativeness, comparability, and completeness defined as follows.

Precision

Laboratory precision is measured by the variability associated with duplicate (two) or replicate (more than two) analyses. One type of sample that can be used to assess laboratory precision is the LCS.

Multiple LCS analyses over the duration of the project can be used to evaluate the overall laboratory precision for the project. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, but between LCSs analyzed in multiple batches.

Total precision is the measurement of the variability associated with the entire sampling and analytical process. The required level of precision for each method, matrix, and analyte are provided in Worksheet #15 (Reference Limits and Evaluation). It is determined by analysis of duplicate field samples and measures variability introduced by both the laboratory and field operations. FD samples and MSD samples shall be analyzed to assess field and laboratory precision at a frequency described in Worksheet #20 (Field Quality Control Sample Summary). For duplicate sample results, the precision is evaluated using the RPD. For replicate results, the precision is measured using the RSD. The formula for the calculation of RPD is provided below.

If calculated from duplicate measurements:

$$RPD = \frac{(C1-C2) \times 100\%}{(C1+C2)/2}$$

Where:
RPD = relative percent difference
C1 = larger of the two observed values
C2 = smaller of the two observed values

Accuracy

Accuracy reflects the total error associated with a measurement. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS to a control limit. For many methods of organic compound analysis, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. The formula for calculation of accuracy is included below as percent recovery (%R).

$$\%R = (A/B) \times 100$$

Where:

A = The analyte concentration determined experimentally from the LCS

B = The known amount of concentration in the sample

Representativeness

Representativeness is the degree to which sample data accurately reflect the characteristics of a population of samples. It is achieved through a well-designed sampling program and by using standardized sampling strategies and techniques and analytical procedures. Factors that can affect representativeness include site homogeneity, sample homogeneity at a single point, and available information around which the sampling program is designed.

Completeness

Completeness is a measure of the amount of valid data obtained compared with the amount expected under correct, normal conditions. It is calculated for the aggregation of data for each analyte measured as a compound of concern for the project objectives. Valid data are data that are usable in the context of the project goals. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an R-flag after a usability assessment has been performed. The goal for completeness, based on specific project goals, is 90 percent.

$$\%\ \text{Completeness} = [(\text{Valid data obtained}) / (\text{Total data planned})] \times 100$$

Comparability

Comparability is the confidence with which one data set can be compared to another. It is achieved by maintaining standard techniques and procedures for collecting and analyzing samples and reporting the analytical results in standard units.

References

CH2M HILL. 2006. *Risk Evaluation for Development of a PCB Sediment Cleanup Level Waukegan Harbor Area of Concern, OMC, Waukegan, Illinois.* July.

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CH2M HILL. 2010. *Prefinal Basis of Design Report for OMC Waukegan Harbor (OU1)*, OMC, Waukegan, Illinois. September.

U.S. Environmental Protection Agency (USEPA). 2008. *National Functional Guidelines for Organic Data Validation.*

U.S. Environmental Protection Agency (USEPA) Region 5. 2009. *Record of Decision Amendment,* OMC, Waukegan, Illinois. October.

Figures

Figure 1
Waukegan Harbor Segments and Property Owners
Waukegan Harbor
Waukegan, Illinois

\\LAKEFRONT\PROJ\EPA\182500_WAUKEGAN_HARBOR\GIS_DATA\MXDS\2010\PRELIMINARY_DESIGN\FIGURE01_WAUKEGAN_HARBOR_SEGMENTS_PROPERTY_OWNERS.MXD MPETERSH 1/27/2010 10:39:59

CH2MHILL

LAKE MICHIGAN

OUTER HARBOR

SECONDARY WATER INTAKE

PRIMARY WATER INTAKE

LAKE MICHIGAN

SAND DUNES

EAST CONTAINMENT CELL (OU-3)

FORMER OMC PLANT 2 BUILDING

GATE

SEA HORSE DR

PUBLIC BEACH

|| BUR

C BUR

SUBMARINE CABLE (BURIED)

BURIED PIPELINE, TYP

ENTRANCE CHANNEL

WAUKEGAN COKE PLANT SITE (OU-2)

BOMBARDIER FACILITY

ELECTRICAL POLE W/ METER

WCP TREATMENT SYSTEM

FIRE HYDRANT

WATER INTAKE

CITY OF WAUKEGAN WATER PLANT

SLIP 4

LARSEN MARINE

RETENTION POND

HARBOR SECTION BOUNDARY LINE, TYP

INNER HARBOR

FEDERAL NAVIGATION CHANNEL

DAHRINGER RD

OMC PLANT 2 SITE (OU-4)

NORTH HARBOR

SLIP 3 (OU-3)

E SEAHORSE DR

WATER MAIN

SOUTH MARINA

WEST CONTAINMENT CELL (OU-3)

INNER HARBOR EXTENSION

ABANDONED WATER MAIN

WAUKEGAN HARBOR (OU-1)

NATIONAL GYPSUM COMPANY

NORTH MARINA

YACHT CLUB

SLIP 1

LAFARGE CORP

WAUKEGAN PORT DISTRICT

E SEAHORSE DR

S PERSHING RD

S PERSHING RD

WAUKEGAN RIVER

N

0 200 400 600

Scale In Feet

NO.	DATE	REVISION	BY	APVD
DSGN	EA MCKENNA	DR	JM HOLMQUIST	
		CHK		APVD

CONCERN AGENCY

SEDIMENT REMEDIATION
WAUKEGAN HARBOR AREA OF CONCERN
U.S. ENVIRONMENTAL PROTECTION AGENCY
WAUKEGAN, ILLINOIS

CH2MHILL

CIVIL
FIGURE 2
OVERALL SITE PLAN

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JANUARY 2010
PROJ	391367
DWG	
SHEET	

FILENAME: fe05c130_391367.dgn PLOT DATE: 1/29/2010 PLOT TIME: 12:35:06 PM

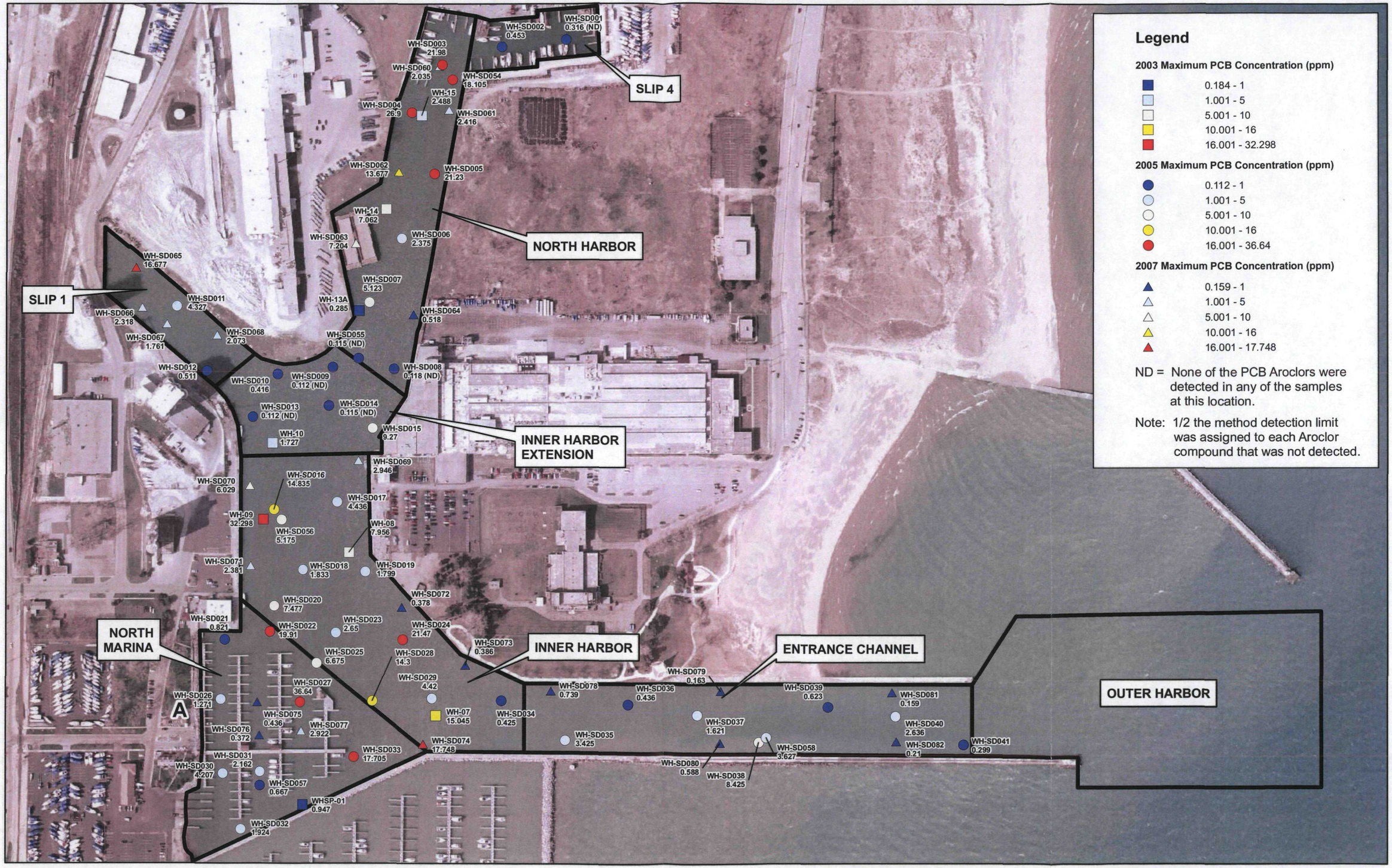


Figure 3
Sediment Sampling Locations and Maximum PCB Concentrations
Waukegan Harbor
Waukegan, Illinois

CH2MHILL

\\LAKEFRONT\PROJ\EPA\182500_WAUKEGAN_HARBOR\GIS_DATA\MXDS\2010\PRELIMINARY_DESIGN\FIGURE05_WAUKEGAN_HARBOR_MAXIMUM_PCB_CONCENTRATIONS.MXD MPETERSH 1/27/2010 12:53:20

LAKE MICHIGAN

SAND DUNES

EAST CONTAINMENT CELL (OU-3)

APPROXIMATE LOCATION OF TRANSFORMER

CONSOLIDATION FACILITY (2) (4)

ELECTRICAL POLE W/ METER

RETENTION POND

DALLMAN RD

WEST CONTAINMENT CELL (OU-3)

OMC PLANT 2 SITE (OU-4)

S PERSHING RD

FORMER OMC PLANT 2 BUILDING

30' WIDE ACCESS ROAD (6)

ROAD CROSSING (6)

30' WIDE ACCESS ROAD (6)

12x8 DW (1)

12" TW ON GRADE (2)

WCP TREATMENT SYSTEM

4" W1 (2)

FIRE HYDRANT

8x8 GUARD SHACK

20' WIDE ACCESS ROAD (6)

TREATMENT FACILITY (2)

30' WIDE ACCESS ROAD (6)

E SEAHORSE DR

SLIP 3 (OU-3)

NATIONAL GYPSUM COMPANY

SILT FENCE, EXACT LOCATION TO BE DETERMINED BY SUBCONTRACTOR

DREDGE SUPPORT MATERIAL STORAGE AREA (1)

SAND STOCK PILE

LARSEN MARINE

SLIP 4

HARBOR SECTION BOUNDARY LINE, TYP

NORTH HARBOR

FLOATING 24" TWEF NOMINAL ROUTING (1)

INTAKE SITE/ DREDGE AREA (1) (2) (1) C-19

WAUKEGAN COKE PLANT SITE (OU-2)

BOMBARDIER FACILITY

INNER HARBOR EXTENSION

WAUKEGAN HARBOR (OU-1)

ABANDONED WATER MAIN

WATER MAIN

NORTH MARINA (5)

YACHT CLUB

SLIP 1

LAFARGE CORP

E SEAHORSE DR

WAUKEGAN PORT DISTRICT

PUBLIC BEACH

TURBIDITY BACKGROUND MONITORING POINT

SECONDARY WATER INTAKE

MONITORING POINT

AIR BUBBLE CURTAIN (1)

C-BUR

// BUR

BURIED PIPELINE, TYP

DISCHARGE POINT (1) (3) C-19

WATER INTAKE

// BUR

CITY OF WAUKEGAN WATER PLANT

INNER HARBOR

FEDERAL NAVIGATION CHANNEL

WATER MAIN

C-BUR

SUBCONTRACTS:

1. DREDGING
2. SEDIMENT PROCESSING SYSTEM CONSTRUCTION
3. SEDIMENT PROCESSING SYSTEM DEMOLITION
4. SEDIMENT PROCESSING SYSTEM OPERATIONS
5. NORTH MARINA DEMOLITION
6. TEMPORARY FACILITIES
7. LAB

N

0 200 400 600

Scale In Feet

NO.	DATE	REVISION	BY	APVD
DSGN	EA MCKENNA	DR	JM HOLMQUIST	CHK	APVD

ISSUED FOR CLIENT REVIEW

CH2MHILL

PACKAGE 1
DREDGING
WAUKEGAN HARBOR - USEPA

FIGURE 4
HYDRAULIC DREDGING
OVERALL SITE PLAN

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	SEPTMEBER 2010
PROJ	391367
DWG	C-2
SHEET	

FILENAME: dn05c111_391367.dgn PLOT DATE: 9/10/2010 PLOT TIME: 3:06:54 PM

Appendix A
Data Management Plan

APPENDIX A

Data Management Plan

The DMP outlines the procedures for storing, handling, accessing, and securing data collected during this remedial action implementation. Data gathered during this remedial action will be consolidated and compiled into a project database system that can be used to evaluate site conditions and data trends. This DMP will serve as a guide for all database users. The DMP is subject to future revision to allow the database management system to be modified as it is developed and maintained. This plan describes the following:

- Responsibilities of the project team for data management
- Data Management System (DMS) to be established for the project
- Development of the base maps onto which the data will be plotted
- Types of data that will be entered into the DMS and the process of data entry

Team Organization and Responsibilities

The following are the team members and their responsibilities for the data management process:

- Project Chemist—Responsible for providing weekly the COC forms and establishing the sample tracking system. Oversees proper use of USEPA's Scribe system and accuracy of the information entered. Reviews lab data for accuracy and quality and compares electronic outputs for accuracy to Lab hard copies. Conducts tracking of samples, forwards tracking information and received data to the Database Manager, and identifies the data inputs (for example, sample numbers) to use in generating tables and plots.
- Database Manager—Responsible for setting up DMS in consultation with the Project Chemist at the beginning of the data evaluation task. Also oversees the data management process including data conversion/manual entry into DMS, quality control of the entered data, and preparation of the required tables and plots of the data. Coordinates with person responsible for reviewing the entered data for QC purposes. Forwards all deliverables to the SM.
- GIS Manager—Responsible for coordinating with SM to set up geodatabase prior to sampling. Maintains spatial layers and over all geodatabase integrity and accuracy. Provides all GIS-related outputs for reports.

Sample Tracking

The Project Chemist is responsible for tracking samples in the sample tracking database to ensure that the analytical results for all samples sent for analysis are received. Copies of COCs from the field team are used to enter in sample IDs, collect date, and analyses. Upon receipt of a sample receipt notice from the laboratory, the date received by the lab and a date the hard copy is due will be entered. Likewise, upon receipt of the hard copy and EDD, the date they were received will also be entered. The date that the data are sent to the USEPA for validation and that the date validation reports are delivered to CH2M HILL will be recorded. The electronic data deliverables will be uploaded when received from the lab, and will be tracked in the sample tracking table. Validation qualifiers will be added to the database and results qualified accordingly.

Data Types

The QAPP, of which this DMP is a part, identifies additional data to be collected for cleanup verification. The data to be collected during the RA include:

- Air PCB, TSP, and Asbestos data
- Water PCB, TSS, and Ammonia data.

These data will be added to the project database as they become available. The data will include new data collected in the laboratory and validated by USEPA or CH2M HILL. The data source will be noted in the database. Procedures for incorporating the data into the database are presented in subsequent sections of this DMP.

Data Tracking and Management

Every data set received from analytical laboratories will be tracked individually. Analytical laboratory reports of chemical analysis results will be tracked in a consistent fashion. Every data set will be assigned a unique identifier. The date of receipt, status of data validation, and status of database entry for each data set will all be tracked and recorded in the project database.

Hard Copy

Measurements made during field data collection activities will be recorded in field logbooks. Field data will be reduced and summarized, tabulated, and stored along with the field logbooks.

All raw analytical laboratory data are stored as the original hard copy. Hard copy information includes COC forms, analytical bench sheets, instrument printouts and chromatograms, certificates of analyses, and QA/QC report summaries. Validation reports will be stored with the hard copy reports.

Data Input Procedures

Sampling information, analytical results, applicable QA/QC data, data validation qualifiers, and other field-related information will be entered into the project database for storage and retrieval during data evaluation and report development. The analytical data will be loaded into the database using EDD files received from the analytical laboratory. Validation qualifiers will be entered manually. Validators will confirm correct data entry by printing validated data reports from the database and manually comparing them to the validated summary analytical forms received from USEPA. Other available field-related data collected, such as water levels or newly installed well information, will be manually entered onto standard EDD templates for loading into the database. Historical data, either in hard copy or electronic form, will be manually entered on or formatted to standard EDD templates for database loading. The entry of other field-related data and historical site data will be confirmed by comparing the hard copy printouts from the database against the hard copies used to perform the data entry. All data entry confirmation procedures and results will be documented.

Computer Database

The technical data, field observations, laboratory analytical results, and analytical data validation will be managed using EQuIS®, a third-party database system by Earthsoft Inc. that is used in USEPA Region 5 to store and analyze project data submissions. The core EQuIS applications are its Chemistry and Geology modules, each of which is associated with its own underlying Microsoft Access database. CH2M HILL owns licenses for the Geology and Chemistry modules. The EQuIS database system is based on a relational model, in which independent tables, each containing a certain type or entity of data, can be linked through selected fields that are common to two or more tables. This database design allows for the inclusion of historical data, and allows users to effectively conduct trend analysis and generate a variety of data reports to aid in data interpretation.

The database must be protected from unauthorized access, tampering, accidental deletions or additions, and data or program loss that can result from power outages or hardware failure. The following procedures will be adopted to ensure this protection:

- The master database will be stored on a network file server local to the installation of the EQuIS data management system. Members of the data management team involved in loading, modifying, or querying the database will be given access through EQuIS user accounts and passwords, as well as the appropriate network server permissions.
- Copies of the master database will be stored on the local area network for access by project staff through reporting tools developed to minimize possible database corruption by users. Whenever the master database is updated or modified, it will be recopied to the local area network to ensure that the current copy is available to users.
- Daily backups of the master database and its copies will be made to ensure that the data will not be lost due to problems with the network.

GIS Description

A project geodatabase will be agreed upon and set up prior to sampling by the SM, Database Manager, and GIS Manager. Workflow for creating, maintaining, and organizing geospatial data will follow the Spatial Data Standard (SDS) format for projects whenever possible.

An ArcView project or extension will be used providing the following functionality: load and display project site basemaps; display sampling station locations and associated sampling data (date, media, results); and perform ad hoc queries to highlight sampling locations meeting user-entered criteria for sampling (for example data by date, sample type, analyte, depth/elevation, result value, or any combination thereof). Results will be shown as stations highlighted on the map.

Documentation

Documentation of data management activities is critical because it provides:

- A hard copy record of project data management activities
- Reference information critical for database users
- Evidence that the activities have been properly planned, executed, and verified
- Continuity of data management operations when personnel changes occur

The DMP will serve as the initial general documentation of the project data management efforts. Additional documentation will be maintained to document specific issues, such as database structure definitions, database inventories, database maintenance, user requests, database issues and problems, and client contact.

Evidence File

The final evidence file will be the central repository for all documents that constitute evidence relevant to sampling and analysis activities. CH2M HILL is the custodian of the evidence file and maintains the contents of the evidence files for the project, including all relevant records, reports, logs, field notebooks, pictures, contractor reports, and data reviews in a secured area with limited access.

CH2M HILL will keep all records until project completion and closeout. As necessary, records may be transferred to an offsite records storage facility. The records storage facility must provide secure, controlled-access records storage. Records of raw analytical laboratory data, QA data, and reports will be kept by the subcontracted laboratory for at least 7 years.

Presentation of Remedial Action Data

Depending on data user needs, data presentation may consist of any of the following formats:

- Tabulated results of data summaries or raw data
- Figures showing concentration isopleths or location-specific concentrations
- Tables providing statistical evaluation or calculation results
- Presentation tools, such as ARCINFO or similar analysis/presentation aids

In addition to laboratory data, other physical data will be collected during field efforts. This information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

Appendix B
Field Operating Procedures

FIELD OPERATING PROCEDURE NO. 1

Surface Water Sampling for TSS and Ammonia

I. Purpose

To provide a general guideline for collecting surface water samples

II. Scope

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for sampling surface water. This procedure can be applied to the collection of surface water samples from streams and other surface water bodies. Surface water samples provide an indication of the amount of contaminant in the surface water body.

If multiple surface water samples are to be collected from a surface water body, samples will be collected from the furthest point downstream, moving upstream as the sampling progresses. Surface water will be sampled before sediment to prevent the collection of fine-grained substrate, which may be introduced into the surface water from sediment sampling activities.

III. Equipment and Materials

- Sample containers
- Unpreserved pre-cleaned and certified wide mouth glass jars for sample collection
- Multi-probe water quality meter for measuring pH, temperature, conductivity, and turbidity - *Optional*
- Global Positioning System (GPS) - *Optional*
- Hip or chest waders

IV. Procedures and Guidelines

1. Sample containers will be rinsed with the sample water prior to collection.
2. Remove the cap from an unpreserved 1-liter polyethylene bottle. Use a new sampling bottle at each sampling location.
3. Hold the bottle upside down, immerse the top of the bottle several inches under the water, then turn the bottle upright to fill. This will prevent floating debris or surface film from entering the sample.
4. Remove the bottle from the water

5. *Optional* - Conductivity, pH, temperature, DO, ORP, and turbidity may be measured before and after sample collection using a multi-probe water quality meter. The multi-probe water quality meter will be calibrated before and after each day of sampling.
6. For all surface water samples, mark the sampling locations on a site map. Photograph (if desired) and describe each location, and place a numbered stake above the visible high water mark on the bank closest to the sampling location. The photographs and descriptions must be adequate to allow the sampling location to be relocated at some future date. Record the following: depth of water at the location, the distance and direction of the location from the shoreline, and qualitative observation of flow conditions.

V. Attachments

None.

VI. Key Checks and Items

- All personnel wearing waders and entering the stream should be certain of their footing so not to slip while in the water. Refer to the Health and Safety Plan for other appropriate health and safety precautions.
- Decontaminate the sampling equipment between sampling locations.
- Avoid disturbing the surface water during submersion of the sample bottles.

FIELD OPERATING PROCEDURE NO. 2

Treatment System Effluent Sampling

I. Purpose

The following describes the procedures for the collection of water treatment system effluent discharge samples.

II. Scope

This procedure is applicable for sampling effluent from a water treatment system that is functioning within its designed specifications, and is considered to be appropriate for collection of analytical samples. The treatment system operator should be consulted for any specific operating procedures.

III. Equipment/Materials

The following list presents the equipment needed for effluent sampling of the water treatment system, as specified in the QAPP.

- Sample bottles and coolers for submittal to the laboratory
- Field notebook, sample data sheets, chain-of-custody forms, and custody seals
- A clean bucket
- Ice for sample coolers
- Appropriate PPE

During the preparation for the field event, this list should be reviewed and modified, as appropriate, to accommodate the needs of the treatment system and/or the collection of additional analytes.

IV. Procedures/Guidelines

Pre-sampling Activities (Purging)

The following activities shall be completed before the start of sampling:

1. Locate a spigot/sample port that will allow samples to be collected following water treatment, such as filters.
2. Confirm that the spigot/sample port selected is deemed acceptable for sampling by the treatment system operator.
3. Open the spigot/sample port, and run water continuously for 10 to 15 seconds to flush.
4. Make sure any water being purged is properly collected or diverted.

Sampling Activities

Procedures for sampling are as follows:

1. Fill all sample containers directly at selected spigot/sample port. Any sample containers containing chemical preservative should not be overfilled.

2. Place all samples in designated sample cooler(s).
3. Make sure spigot/sampling port is shut off before leaving.

V. Attachments

None.

VI. Key Checks/Items

- Sample port location.
- Flush sample port.
- Sources of contamination.

FIELD OPERATING PROCEDURE NO. 3

Sample Handling, Packaging, and Shipment

I. Purpose

The purpose of this FOP is to describe the handling, packaging and shipment of environmental samples.

II. Sample Packaging

Sample packaging and shipping procedures are designed to ensure that the samples will arrive at the laboratory, along with the COC, intact. Whenever possible, sample tags and COC forms will be produced by the most recent version of the software *Forms II Lite ver. 5.1* per FOP#4. Samples will be packaged for shipment as outlined below:

- All sample containers will have affixed sample tags.
- Caps on the sample containers will be checked to ensure they are properly sealed.
- COC forms will be completed with required sampling information, and recorded information will match the sample tags.
- If the designated sampler relinquishes samples to other sampling or field crew member for packing or other purposes, the sampler will complete the COC prior to this transfer.
- Appropriate personnel will sign and date COCs to document the sample custody transfer.
- The outside drain plug at the bottom of the cooler will be secured inside and out using duct tape.
- Sample containers will be protected in bubble wrap or other cushioning material. 1 to 2 inches of cushioning material will be placed at the bottom of the cooler. Vermiculite will not be used as a cushioning material in accordance with the August 31, 2000 memo from the USEPA Regional Safety Manager, which suspended the use of this material for sample packaging.
- Sealed sample containers will be placed in the cooler.
- Ice will be double bagged with plastic zipper bags. Bags will be sealed and placed loosely in the cooler. Remaining space in the cooler will be filled with cushioning material.
- COC forms will be placed in a sealed plastic bag and taped to the inside of the cooler lid.
- Temperature blanks will accompany all samples transported to the laboratory.
- The lid of the cooler will be closed, locked, and secured with tape. Strapping tape will be wrapped around both ends of the cooler at least twice.
- The cooler will be marked on the outside with the following information: shipping address, return address, "fragile" labels, and arrows indicating "this side up."

- Labels will be covered with clear plastic tape.
- USEPA Region V custody seals will be placed over opposite corners of the cooler lid and covered with clear plastic tape.
- All coolers will be shipped or sent by courier with the samples to the analytical laboratory(s) by express overnight service or courier service.
- All samples will be transported or shipped in a manner that protects integrity of the samples and safety of the handlers.
- Original COC forms will accompany the shipment; copies will be retained by the sampler for sampling records.
- If samples are sent by common carrier, bills of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation.
- Commercial carriers will not be required to sign off on COC forms as long as the forms are sealed inside the sample cooler and the custody seals remain intact.
- Packaging, marking, labeling, and shipping of samples will comply with the regulations promulgated by the U.S. Department of Transportation in the Code of Federal Regulations (49 CFR 171-177).
- Field samples will be analyzed as soon as possible after receipt at the laboratory.

III. Shipping

If samples are shipped by commercial carrier, customer copies of airbills will be retained to provide a record for sample shipment to the laboratory. Completed airbills will accompany shipped samples to the laboratory and will be forwarded along with data packages. The airbill number will be documented on the COC accompanying the samples to the laboratory for sample tracking purposes. Airbills will be kept as part of the data packages in the project files.

IV. Attachments

None.

FIELD OPERATING PROCEDURE NO. 4

Documentation/Chain-of-Custody Procedure

I. Purpose

The purpose of this FOP is to provide a definition of "custody" and describe protocols for documenting the transfer of custody from one party to the next (e.g., from the site to the laboratory). A documented custody trail is established through the use of sample tags and a USEPA chain-of-custody form which uniquely identifies each sample container, and who has possession of it from the sample's origin to its final destination. The chain-of-custody form also describes the sampling point, date, time, and analysis parameters.

II. Scope

Sample personnel should be aware that a sample is considered to be in a person's custody if the sample meets the following conditions:

- It is in a person's actual possession
- It is in view after being in a person's possession
- It is locked up so that no one can tamper with it after having been in physical custody

When samples leave the custody of the sampler, the cooler must be custody-sealed and possession must be documented.

Data generated from the use of this FOP may be used to support the following activities: site characterization, risk assessment, and evaluation of remedial alternatives.

III. Equipment and Materials

- Computer with Scribe software loaded
- Printer with paper (8.5- × 11-inch) and ink cartridge (black or color)
- USEPA Region 5 Sample Tag
- Forms II Lite generated tag label (encouraged, but not mandatory)
- Indelible black ink pen

IV. Procedures and Guidelines

Chain-of-Custody Forms

The chain of custody form must contain the following information:

- CASE NUMBER/CLIENT NUMBER: If a CLP laboratory is used, enter the case number provided by EPA's RSCC. If the CLP is not used, enter the SAS number provided by CH2M HILL's Sample and Analytical Coordinator.
- USEPA REGION: Enter Region "5."
- CERCLIS ID: For WH, use "ILD000802827."

- SPILL ID: For WH, use "0528."
- SITE NAME/STATE: For OMC, this will be "OMC WAUKEGAN HABOR OU1", "IL."
- PROJECT LEADER: Enter the CH2M HILL Site Manager.
- ACTION: For WH, choose "Remedial Action."
- SAMPLING CO.: "CH2M HILL."
- SAMPLE NO.: This is the unique number that will be used for sample tracking. For CLP, this number is taken from a block of numbers assigned by the EPA RSCC. For non-CLP, the CH2M HILL Sample and Analytical Coordinator will assign this number.
- MATRIX: Describes the sample media (e.g. groundwater, soil, wipe, etc.).
- SAMPLER NAME: The name of the sampler or sample team leader.
- CONCENTRATION: Low (L), Low/Medium (M) or High (H).
- SAMPLE TYPE: "Grab" or "Composite."
- ANALYSIS: This indicates the analyses required for each sample.
- TAG NO.: This number appears on the bottom of the sample tag and includes a prefix ("5") followed by a series of numbers. The entire number must appear on the chain-of-custody form.
- PRESERVATIVE: Document what preservative has been added to the sample (e.g. "HCl," "ice only," "none").
- STATION LOCATION: This is the CH2M HILL Station Location Identifier.
- SAMPLE COLLECT DATE/TIME: Use military time.
- QC TYPE: This is for field QC only, and includes field duplicate, field blanks, equipment blanks, and trip blanks.
- DATE SHIPPED: The date that samples are relinquished to the shipping carrier.
- CARRIER NAME: (e.g., "FedEx").
- AIRBILL: Airbill number used for shipping. (If samples are hand delivered to their destination, "hand delivered" should appear in this field.)
- SHIPPED TO: This is the laboratory name and full address, including the laboratory contact. If the contact is not known, use "Sample Custodian."
- CHAIN OF CUSTODY RECORD fields: This sampler's signature must appear in the "Sampler Signature" and the "Relinquished By" fields. The date and time (military time) must also be included. If additional personnel were involved in sampling, their signatures should appear in the "Additional Sampler Signature(s)" field.

  Although the samples are "relinquished" to the shipping carrier, the shipping carrier does not have access to the samples as long as the shipping cooler is custody sealed. Consequently, the shipping carrier does not sign the chain-of-custody form.

- SAMPLE(S) TO BE USED FOR LABORATORY QC: This identifies which samples are to be used for matrix spike/matrix spike duplicate analyses.
- Indicate if shipment for case is complete: Use "Y" or "N."
- CHAIN-OF-CUSTODY SEAL NUMBER: Record the custody seal numbers that appear on the Region 5 custody seals that can be found on the shipping container. There is usually a minimum of two per shipping container.

Sample Tags

Each sample container will be identified with a uniquely numbered sample tag issued by USEPA Region 5. Each tag will contain the following information:

- Case/SAS number
- The unique sample number for sample tracking
- CH2M HILL station location (i.e., the sample identifier)
- Date of sampling
- Time the sample was collected (in military time)
- All parameters for which the sample will be analyzed
- Preservative used (if any)
- Sample type (grab or composite)
- Sample concentration (low, medium, high)
- Sample matrix (groundwater, soil, air, etc.)
- The signature of sample team leader
- Identification when sample is intended to be used by the lab for matrix spike/spike duplicate

V. Attachments

- Attachment 1: User Manual for Scribe CLP Sampling
- Attachment 2: Chain-of-Custody Form, Sample Tag, Custody Seal

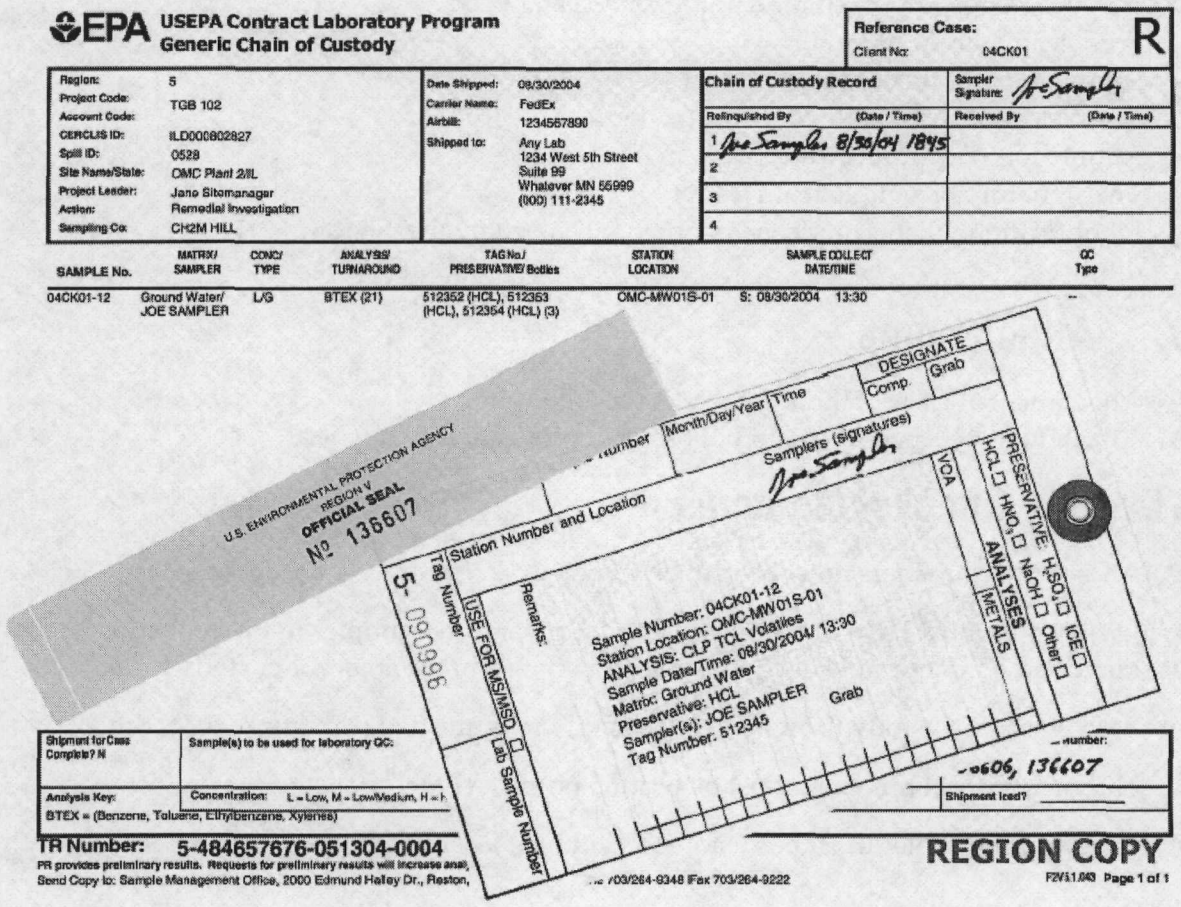
VI. Key Checks and Items

- All sample containers must be properly tagged.
- Each cooler must have a chain-of-custody form and the samples in the cooler (as identified by the sample tags) must match what is on the chain-of-custody form.
- Each chain-of-custody form must be properly relinquished (signature, date, time).
- The custody seal numbers must be written on each chain-of-custody form.
- The shipping cooler must be custody sealed in at least two places.

VII. FOP-4, Attachment 1
User Manual for Scribe CLP Sampling

See Attachment 1 for a step by step guide.

VIII. FOP-4, Attachment 2
Chain-of-Custody Form, Sample Tag, Custody Seal



EPA USEPA Contract Laboratory Program
Generic Chain of Custody

Reference Case: R
Client No: 04CK01

Region:	5	Date Shipped:	08/30/2004	Chain of Custody Record	Sampler Signature: Joe Sampler
Project Code: / Account Code:	TGB 102	Carrier Name:	FedEx	Relinquished By (Date / Time)	Received By (Date / Time)
CERCLIS ID:	ILD000802827	Airbill:	1234567890	1 Joe Sampler 8/30/04 1845	
Spill ID:	0528	Shipped to:	Any Lab 1234 West 5th Street Suite 99 Whatever MN 55999 (000) 111-2345	2	
Site Name/State:	OMC Plant 2/IL			3	
Project Leader:	Jane Sitemanager			4	
Action:	Remedial Investigation				
Sampling Co:	CH2M HILL				

SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME	QC Type
04CK01-12	Ground Water/ JOE SAMPLER	L/G	BTEX (21)	512352 (HCL), 512353 (HCL), 512354 (HCL) (3)	OMC-MW01S-01	S: 08/30/2004 13:30	

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION V
OFFICIAL SEAL
No 136607

DESIGNATE: Grab / Comp
Month/Day/Year | Time
Samplers (signatures): Joe Sampler
Station Number and Location
Tag Number: 090996
Remarks:
Sample Number: 04CK01-12
Station Location: OMC-MW01S-01
ANALYSIS: CLP TCL Volatiles
Sample Date/Time: 08/30/2004/ 13:30
Matrix: Ground Water
Preservative: HCL
Sampler(s): JOE SAMPLER Grab
Tag Number: 512345
PRESERVATIVE: HCL ☐ HNO3 ☐ NaOH ☐ H2SO4 ☐ ICE ☐ Other ☐
ANALYSES: VOA / METALS
USE FOR MS/MSD ☐
Lab Sample Number

Shipment for Case Complete? N	Sample(s) to be used for laboratory QC:
Analysis Key:	Concentration: L = Low, M = Low/Medium, H = H

BTEX = (Benzene, Toluene, Ethylbenzene, Xylenes)

Number: -0606, 136607
Shipment Iced?

TR Number: 5-484657676-051304-0004
PR provides preliminary results. Requests for preliminary results will increase anal
Send Copy to: Sample Management Office, 2000 Edmund Halley Dr., Reston, ... 703/264-9348 /Fax 703/264-9222

REGION COPY
F2V5.1.043 Page 1 of 1

ERT

USER MANUAL
for
SCRIBE CLP SAMPLING

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Modification Date: June 11, 2010

INTRODUCTION

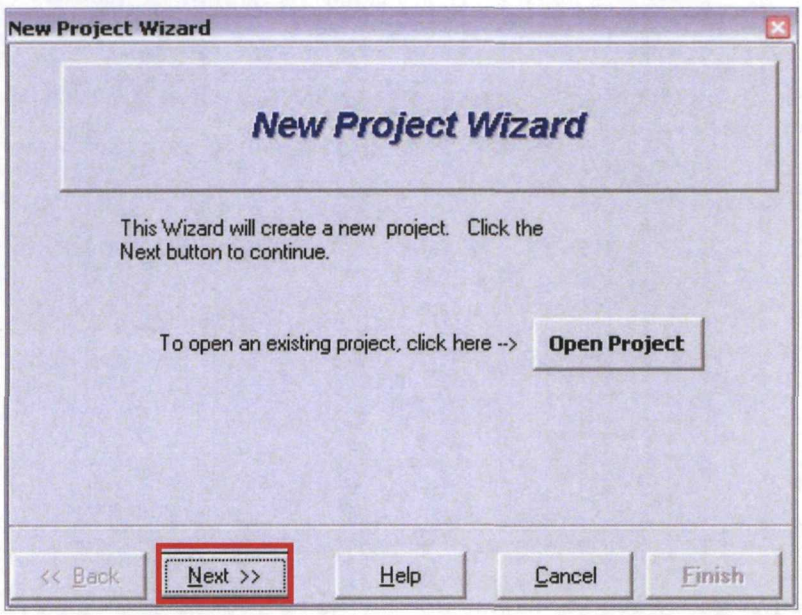
The intent of this User Guide is to provide a basic overview of how to use Scribe to create a new sampling project and manage samples collected for the EPA's Contract Lab Program (CLP). Scribe provides support for CLP sample documentation including the CLP Chain of Custody (COC) reports and the CLP XML format.Query. This document also assumes that the user is already familiar with the Scribe application for sampling. Otherwise, please refer to the Scribe User guides for detailed Scribe application instructions.

Create a New Project

New Project Wizard

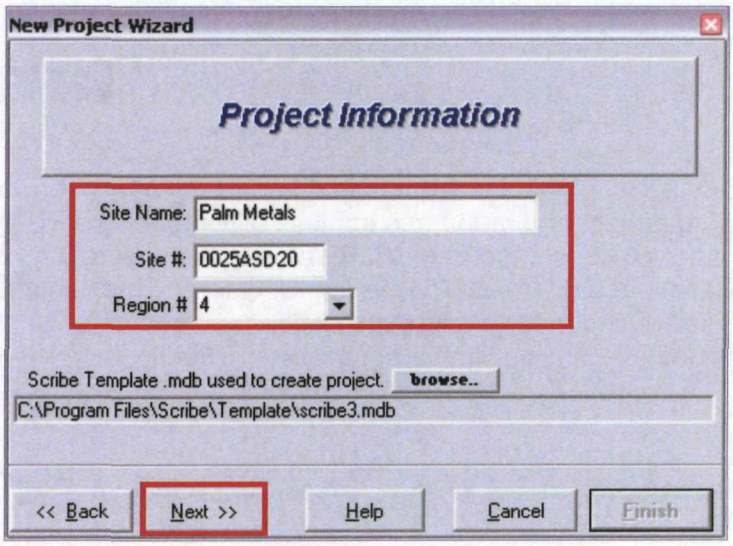
If you are starting Scribe for the first time after installation, the New Project Wizard will run automatically. Otherwise, to create a new project in Scribe:

1. Click on '**File**'.
2. Select '**New Project**'.
3. A New Project Wizard window is displayed.



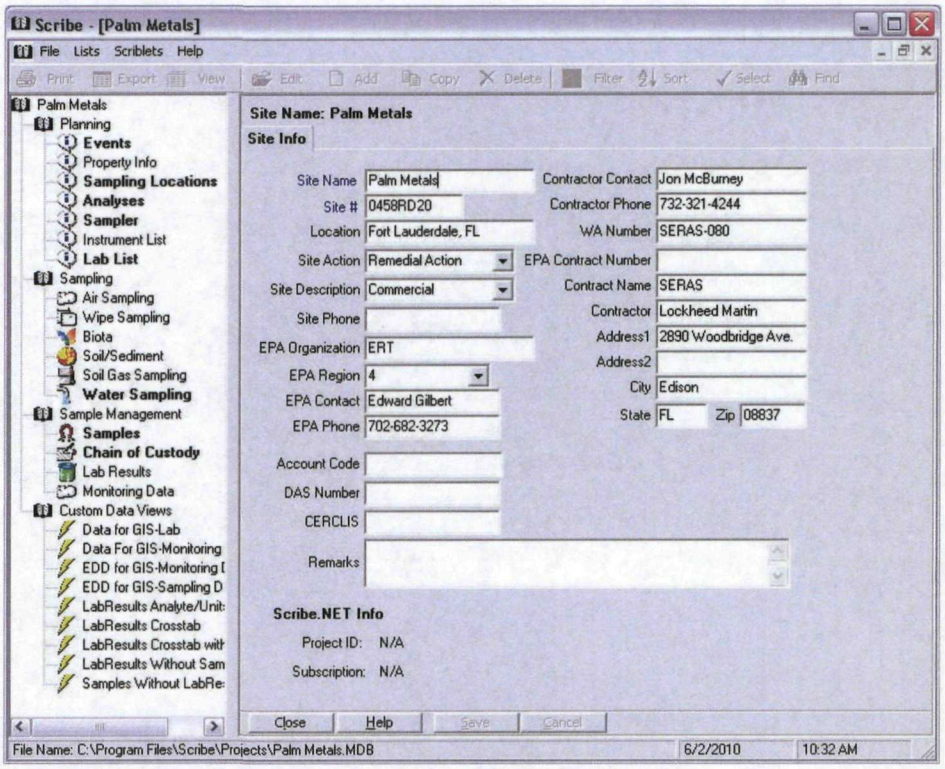
4. Click '**Next**' to continue.

5. Enter the Project Information.



6. Enter the **Site Name**, **Site #** and **EPA Region #**.

7. Click '**Next**' and then click '**Finish**' to create the new project.



The New Project Wizard closes and the "**Site Info**" screen displays. ONLY the field names in **BLUE** are required but we recommend completing as many fields as possible.

CLP SAMPLING IN SCRIBE

CLP Samples

CLP Analyses

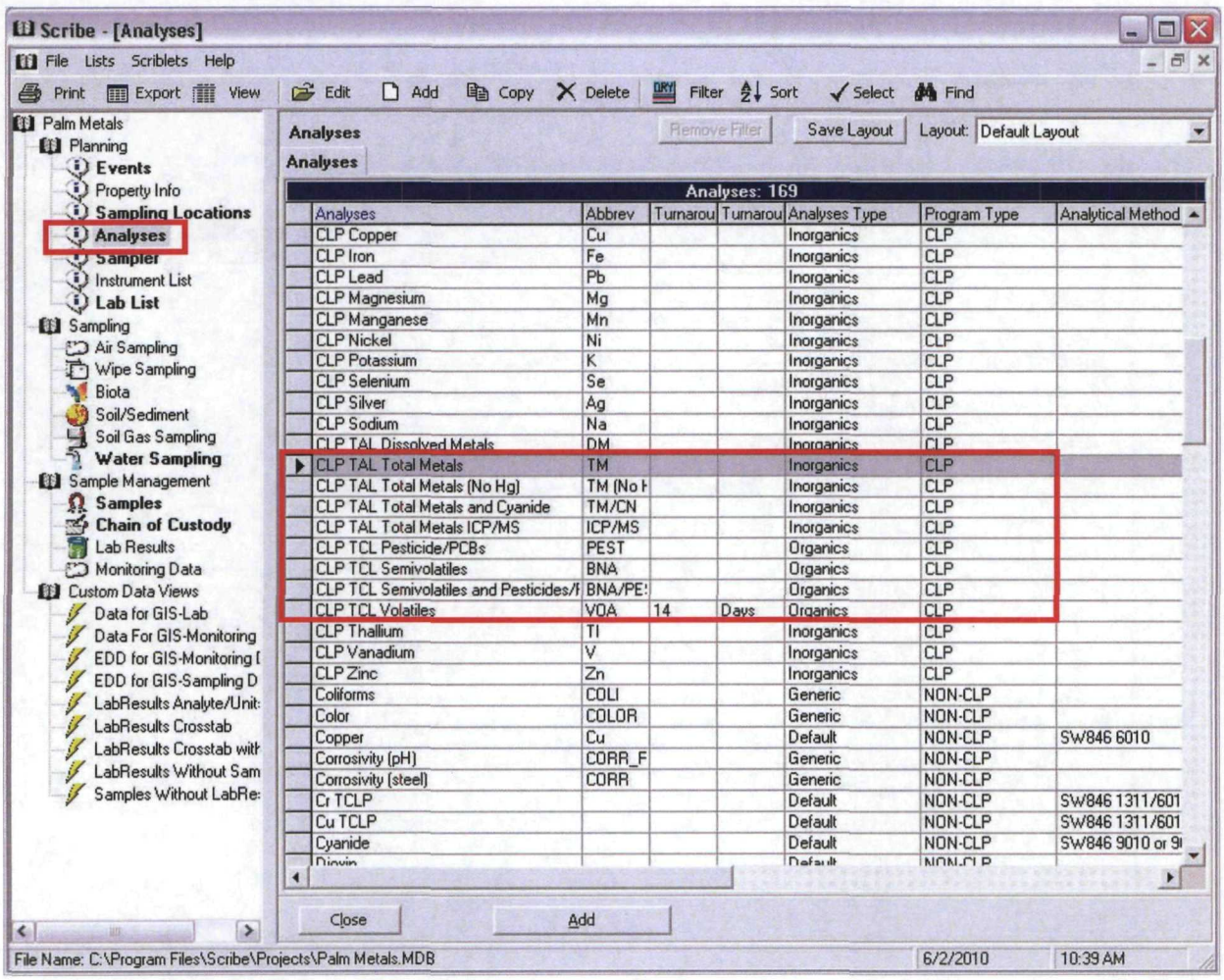
The Scribe Analyses List now includes CLP Analyses. To view or modify the list:

1. Click on "**Analyses**" in the left Navigation Pane. This section is used to manage a list of Analyses including the Program Type and Analysis Type. For example:

   Analysis: CLP TAL Total Metals

   Program Type: CLP

   Analyses Type: Inorganics



CLP/Tag Settings

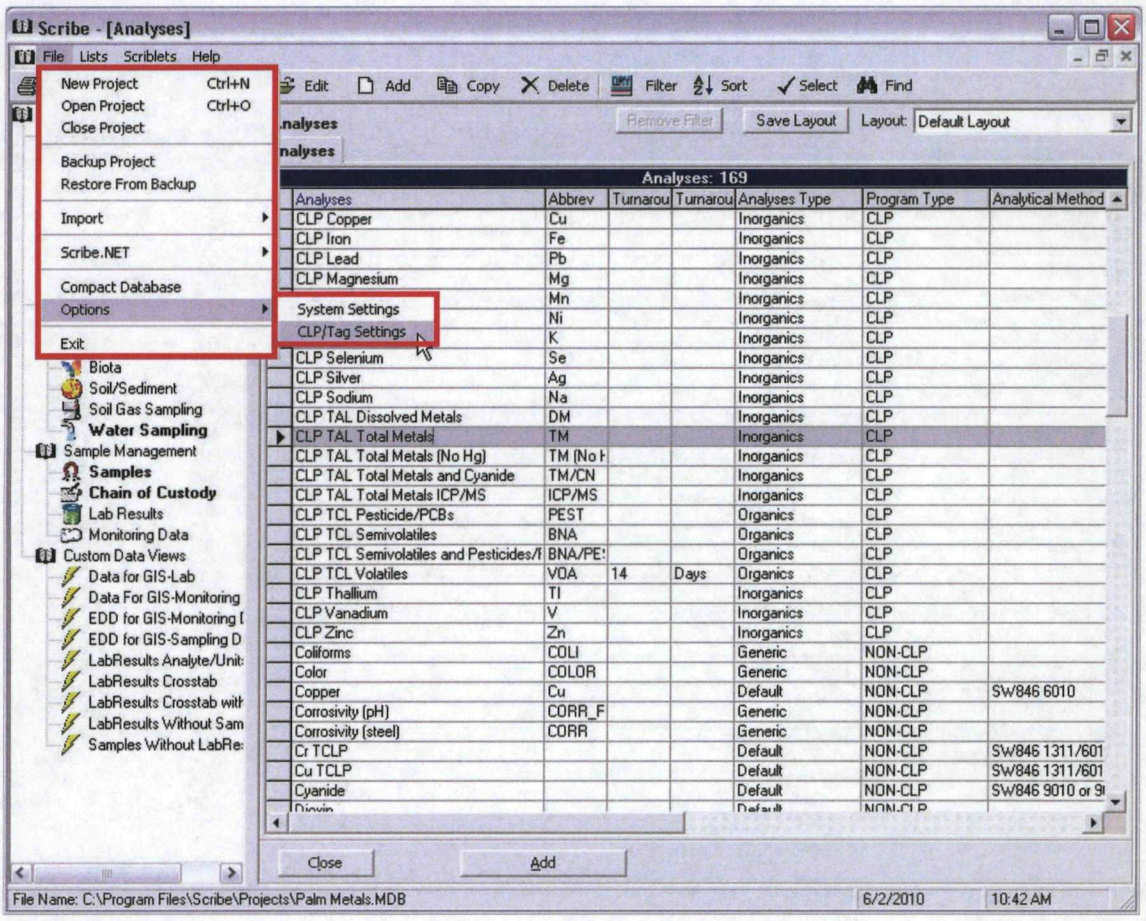
A new feature included with CLP Analyses is the ability to set defaults for the CLP Tags. When a CLP Analysis is selected for a sample, Scribe will assign a CLP Sample number. You can set the **Next CLP Sample number** and **Next Tag number** similar to a sample mask but not exactly.

The CLP Sample # and the Tag # is a field that will update as Samples are added to Scribe. This number is a DISPLAY of the Next number to be assigned. It is editable so that you may customize the next CLP Sample Number that you would like Scribe to assign to your samples.

The numbers auto-increment as samples are added using the CLP business rules.

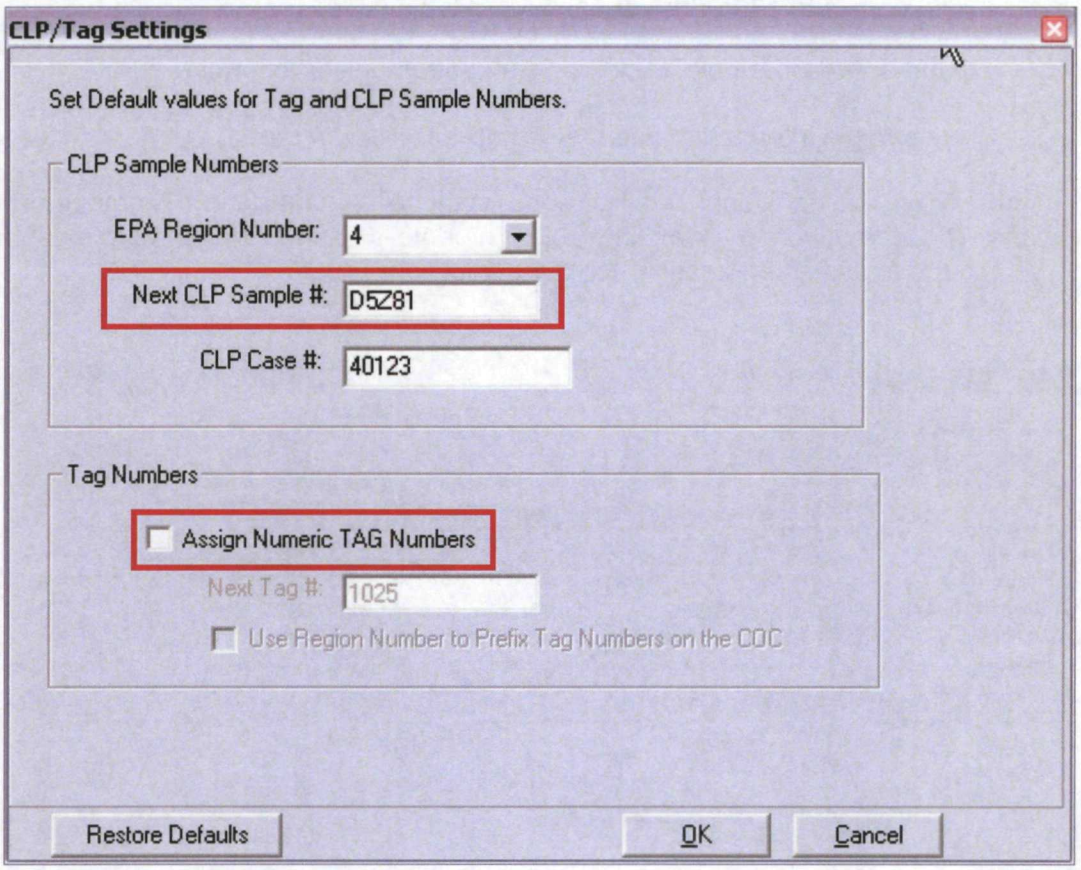
To modify the default settings:

1. Click on **File**.
2. Select **Options**.
3. Select **CLP/Tag Settings**.



4. The window for CLP/Tag Settings is displayed.

5. Input the appropriate information and click the '**OK**' button to Save and Close.

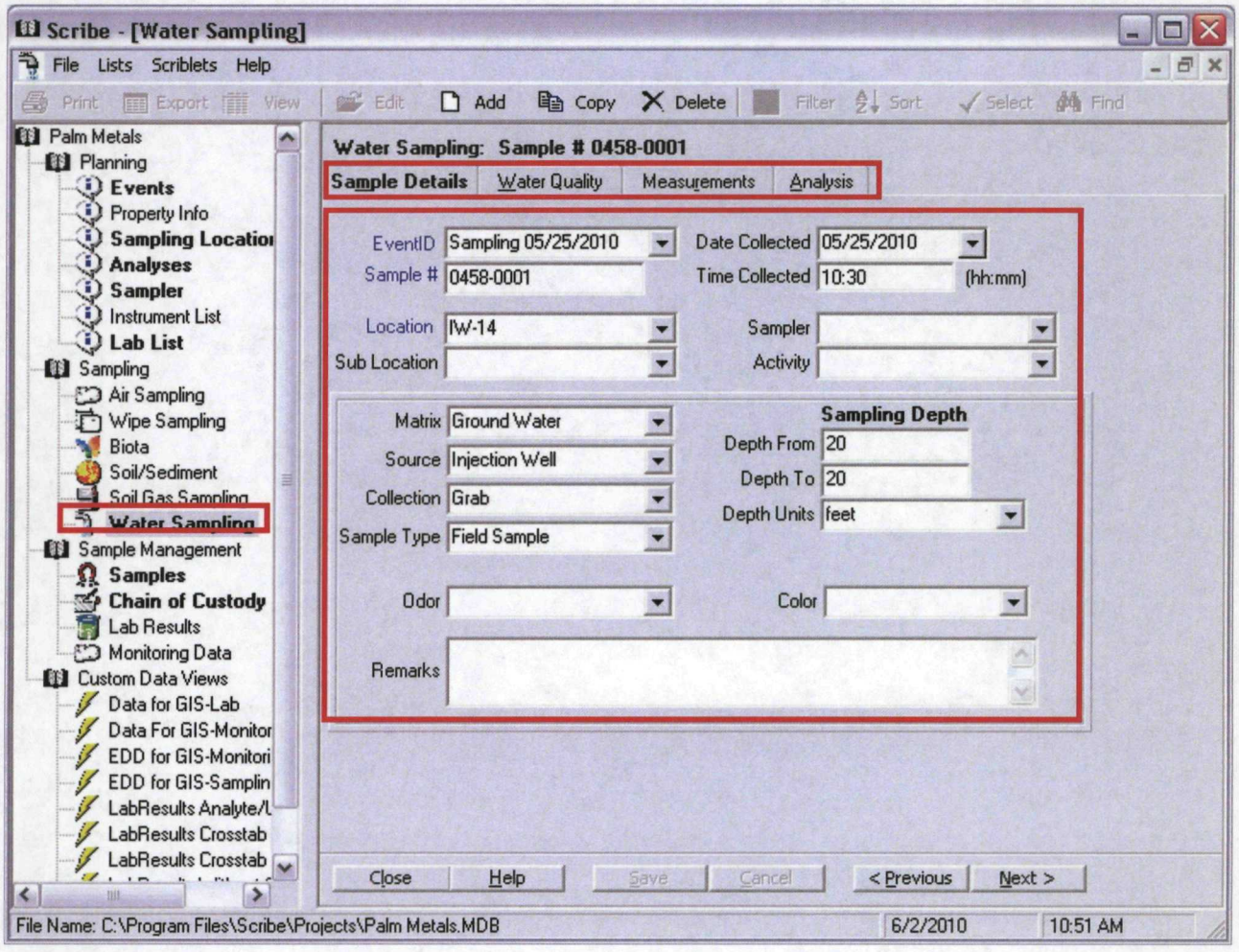


Adding CLP Samples and Assigning Analyses

Depending on the type of sampling, click on the appropriate sampling task under Sampling in the left Navigation Pane. For example,

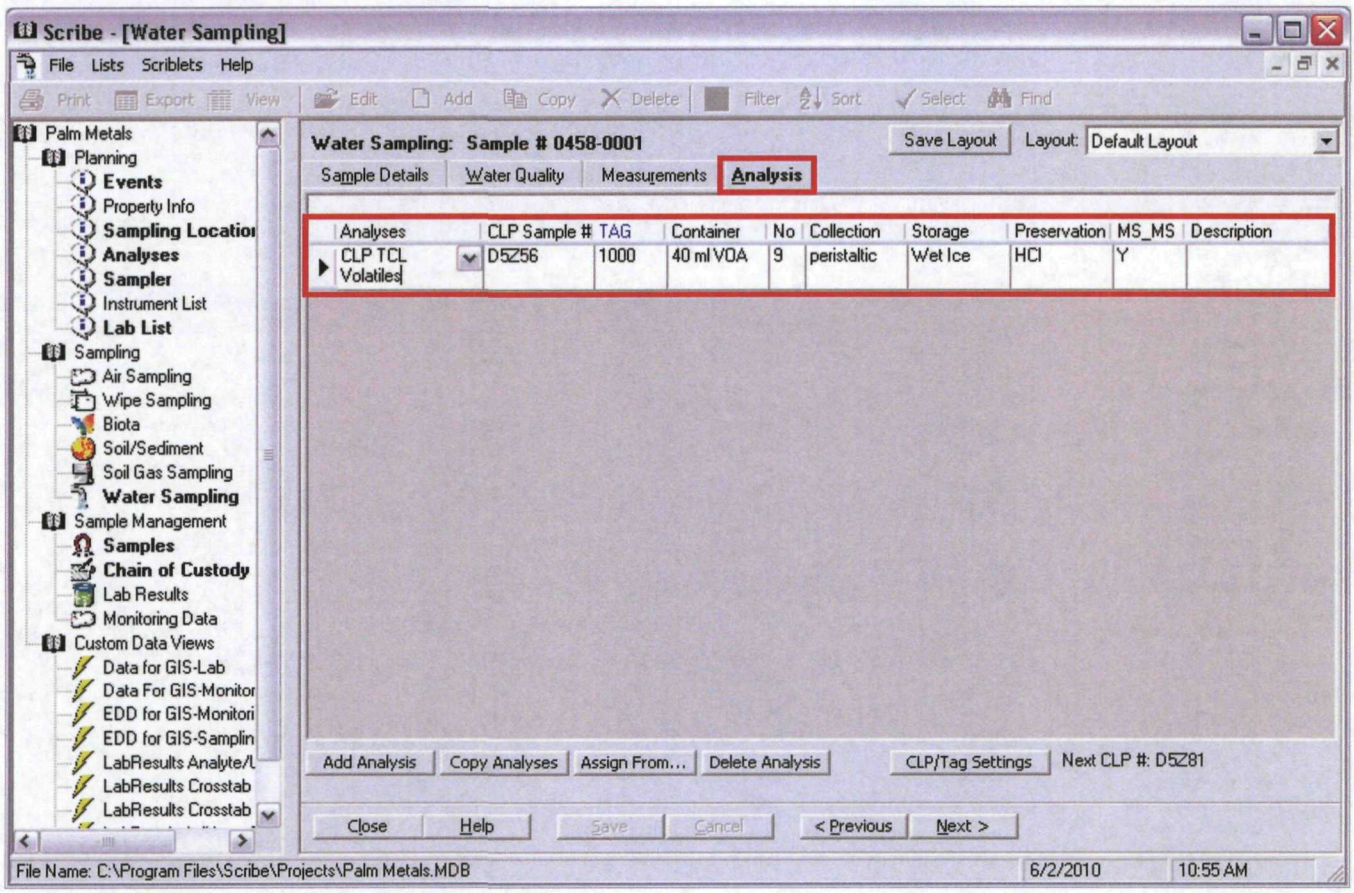
1. Click on '**Water Sampling**' in the left Navigation bar.
2. To add a Water Sample, click the '**Add**' button on the top menu.
3. Enter sample information into the "**Sample Details**" screen.

Note: There are additional detail screens on the Water Quality and Measurements tabs. These tabs vary by sampling task. The details on the **Analysis** tab must be completed to assign an analysis to your sample.



Enter Analysis information for the Sample and assign CLP Sample and Tag numbers.

4. Click on the **Analysis** tab.
5. Click in the **Analyses field**.
6. Click on the **down arrow** for a list of the CLP Analyses that we referred to earlier.
7. Select an Analysis.



8. For a CLP Analysis, a Tag number and a CLP Sample number is assigned based on the CLP/Tag Settings.
9. To assign additional Analyses to sample containers, click the '**Add Analysis**' button.
10. When all analyses have been added, click the '**Close**' button on the bottom of the window to save and close.

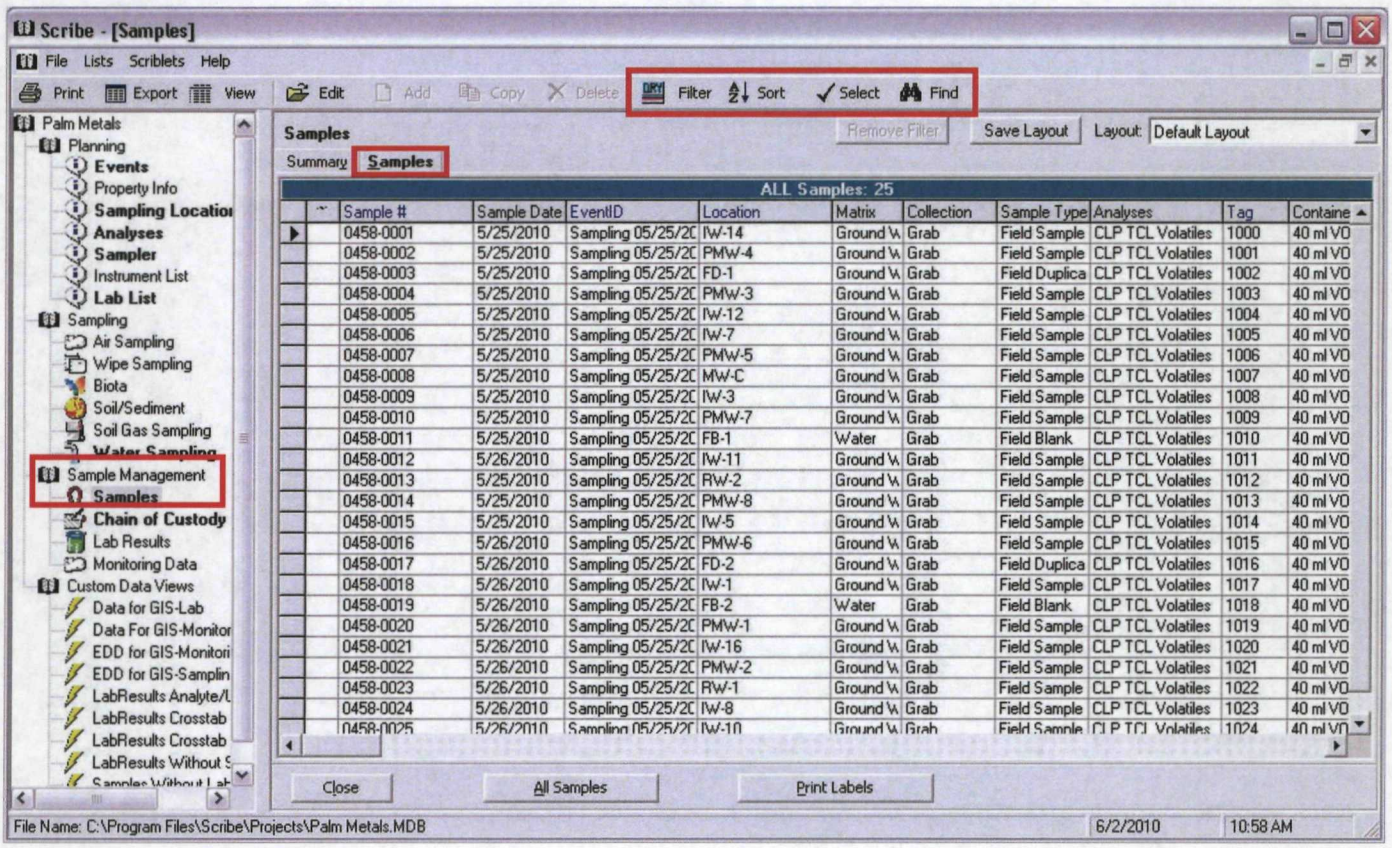
View Samples

Sample Management

Under Sample Management in the left Navigation Pane, you can view and manage all samples using Find, Filter and Sort. The options to Print labels and Chains of Custody are also available.

To view samples:

1. Click on '**Samples**' under Sample Management in the left Navigation Pane.

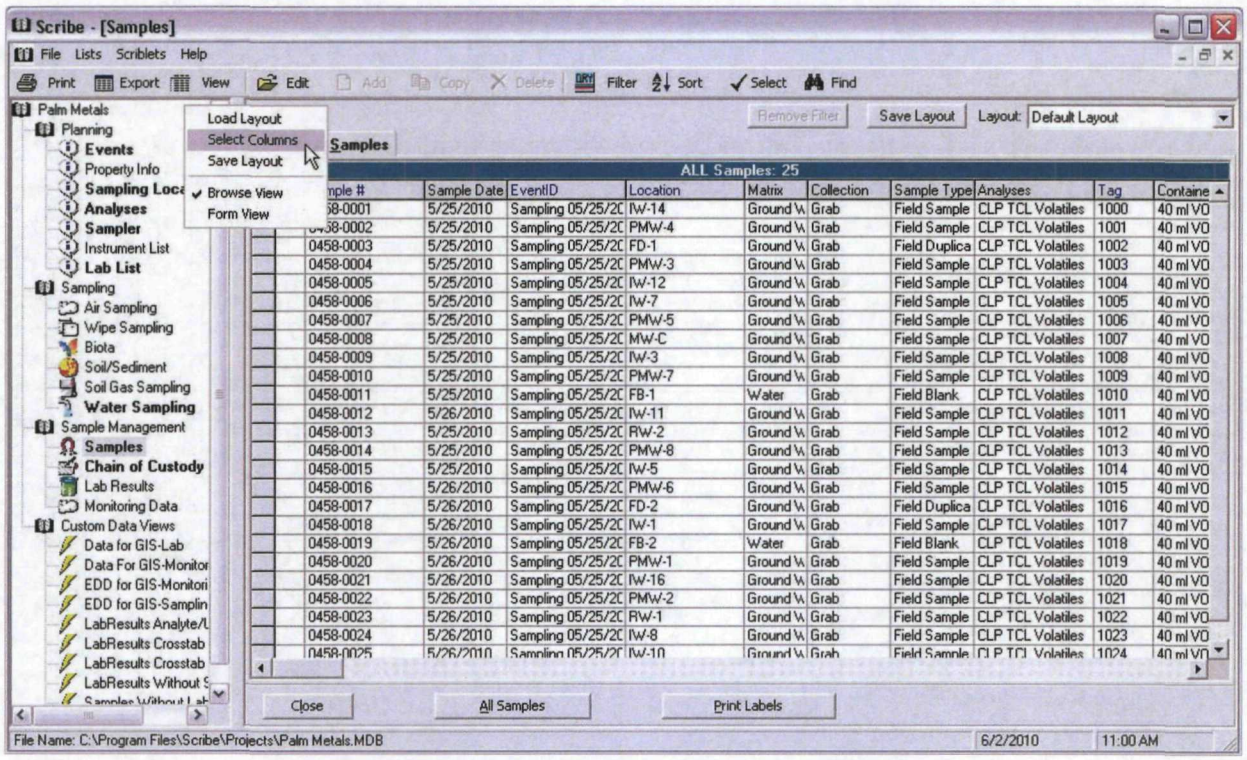


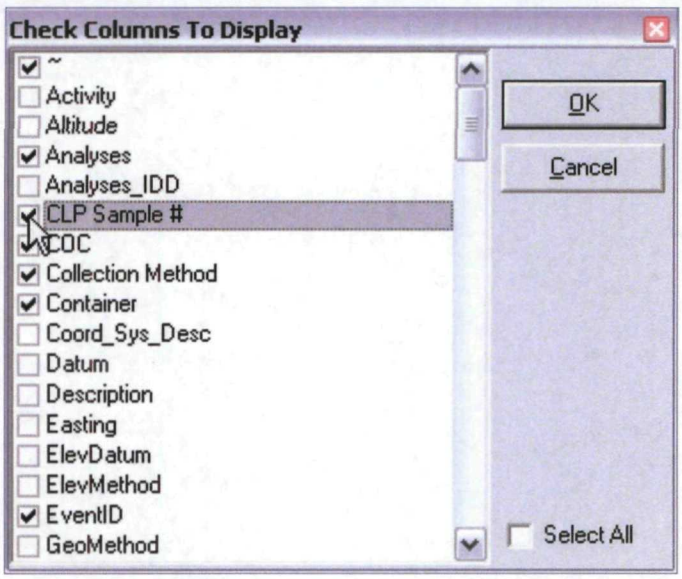
2. To filter your view of samples, RT-click on the field to filter on and select the '**Filter for…**' option. For multi-level filters, click the '**Filter**' button on the top menu bar.

3. To sort your view of samples, RT-click on the column heading and select a sort option. For advanced sort options, click on the '**Sort**' button on the top menu bar.

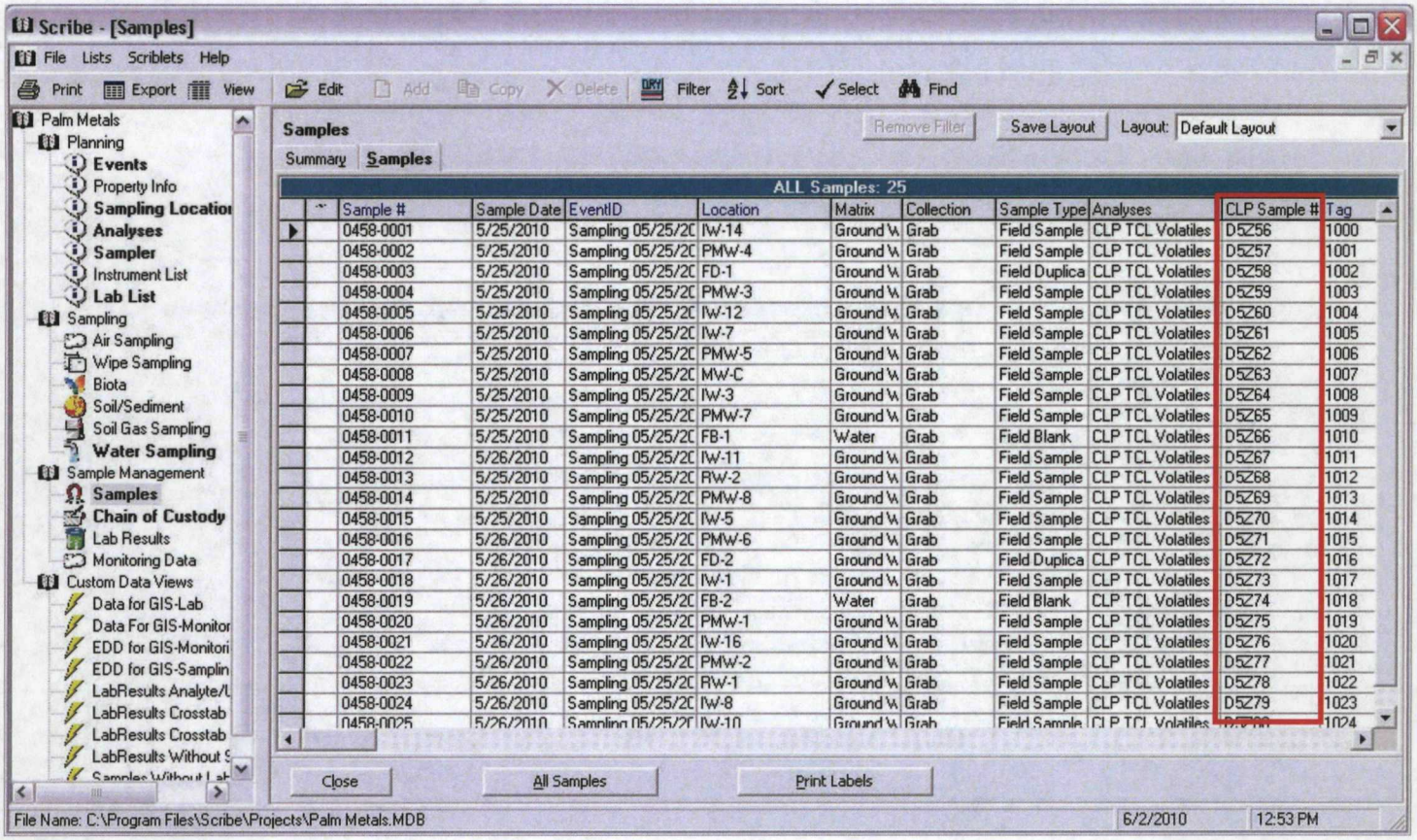
4. To find a particular sample(s), RT-click on the field and select the appropriate option. For multi-level finds, click the '**Find**' button on the top menu bar.

5. To see CLP Sample information including the **CLP Sample #,** click the drop-down menu for the Layout field on the top right corner of the window and select the '**CLP Layout**'.





6. The **CLP Sample #** column is now exposed.



LABELS AND CHAIN OF CUSTODY

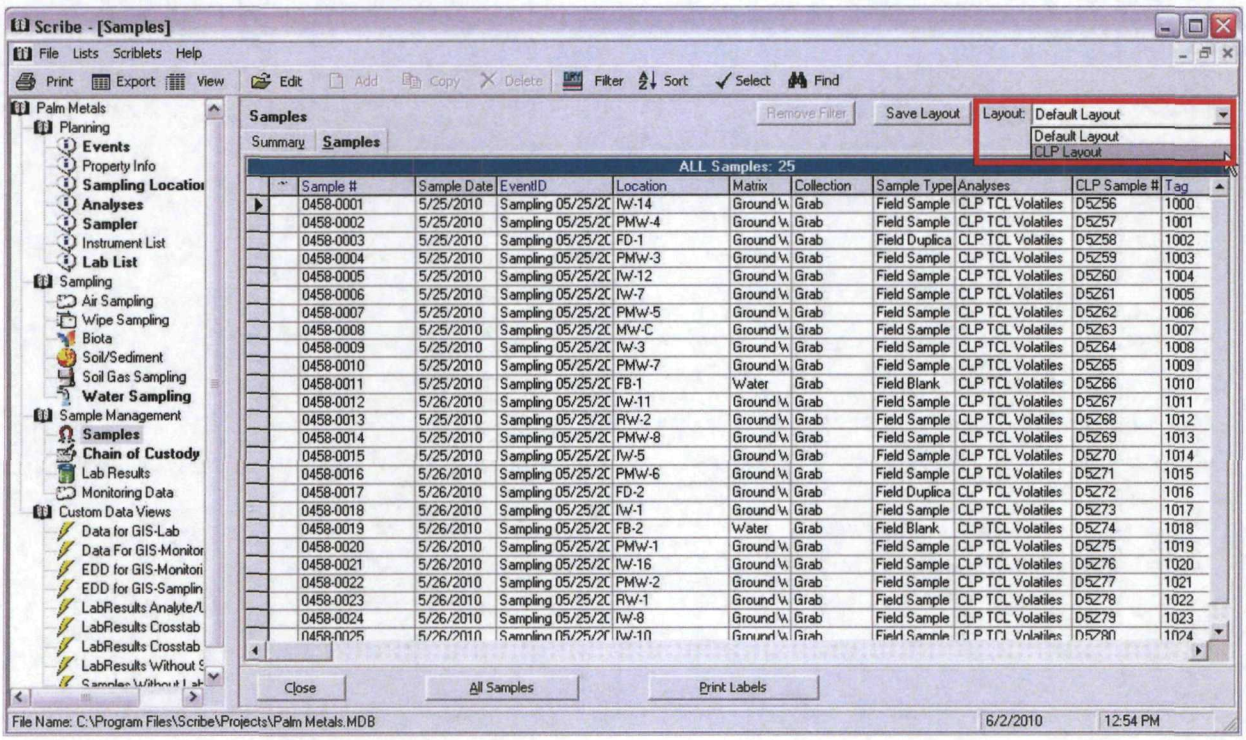
CLP Sample Labels

Print Sample Labels

Label options are available through the Samples View. Click on '**Samples**' under Sample Management in the left Navigation Pane. All samples shown on the screen are available to be printed on labels. You can apply Filters, Finds and Sorts to limit the display to the Samples you wish to see.

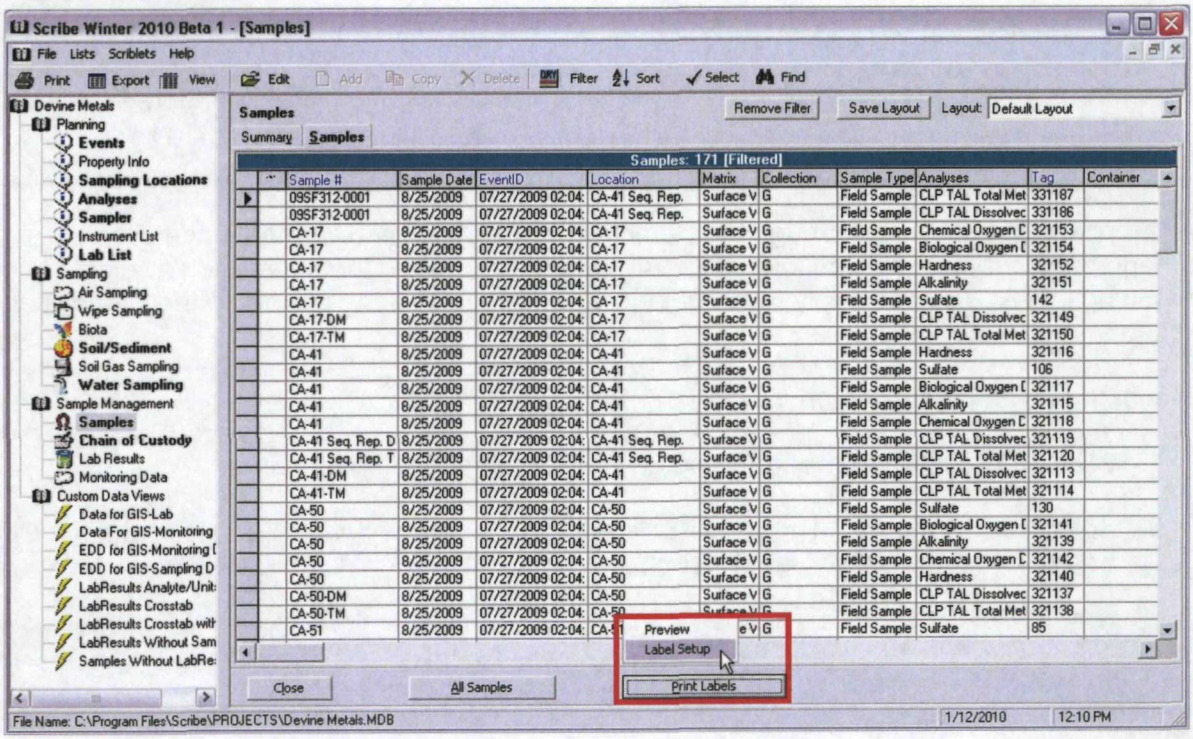
To configure your labels and print:

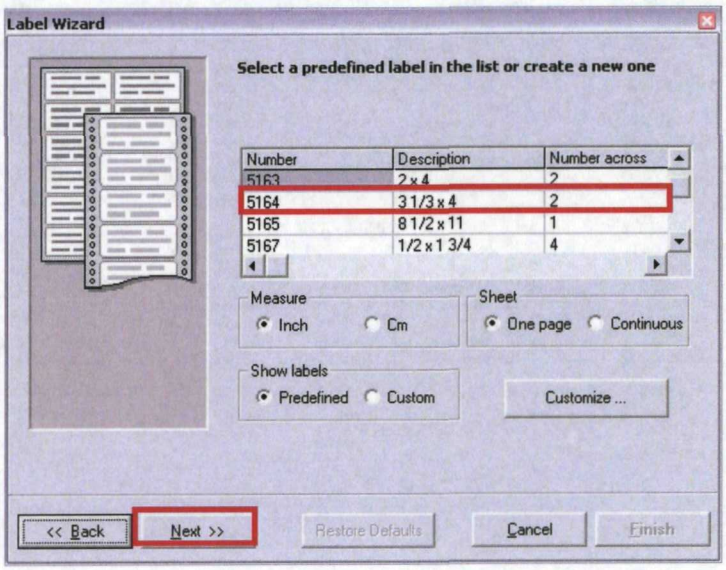
1. Click on **drop-down menu** for the Layout field on the top right corner.
2. Select '**CLP Layout**'. This layout will replace the default Scribe Sample # with the CLP Sample # on the default label layout.



3. Click the '**Print Labels**' button on the bottom of the window.
4. Select '**Label Setup**' if it's the first time you are setting up a label.

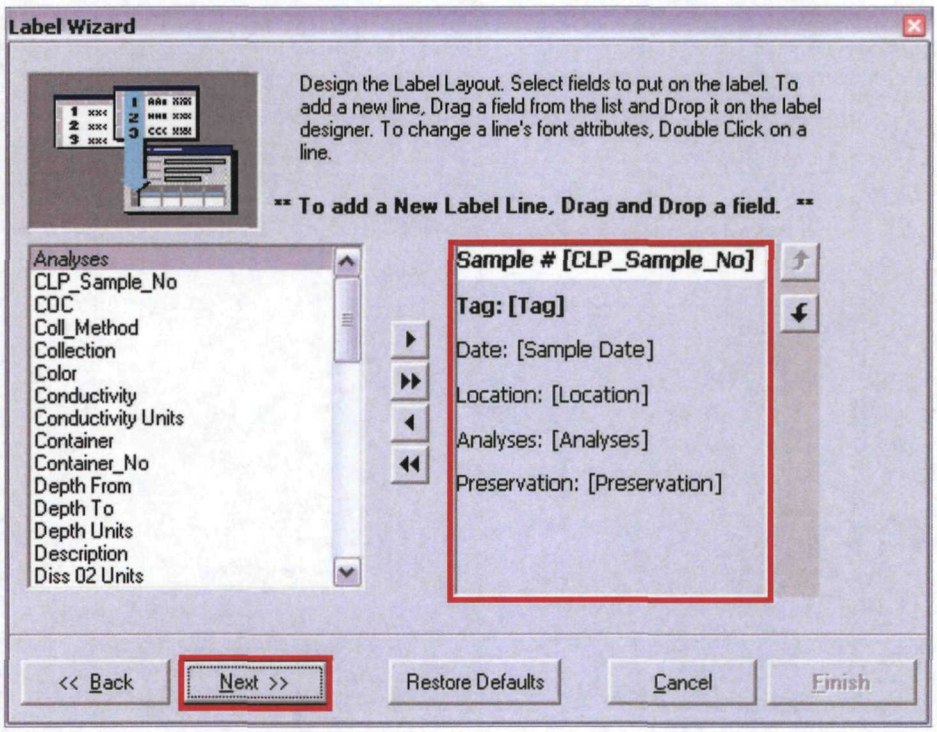
5. Select a pre-defined label format that matches your labels.





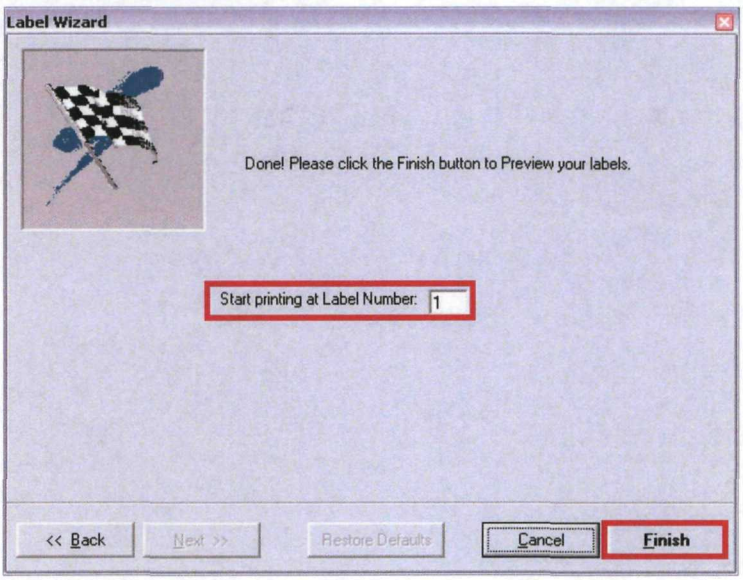
6. Click '**Next**' to continue.

7. Design your label by adding/removing fields to or use the default design. **Note:** The CLP Sample number instead of the Scribe Sample number will be printed on the label.

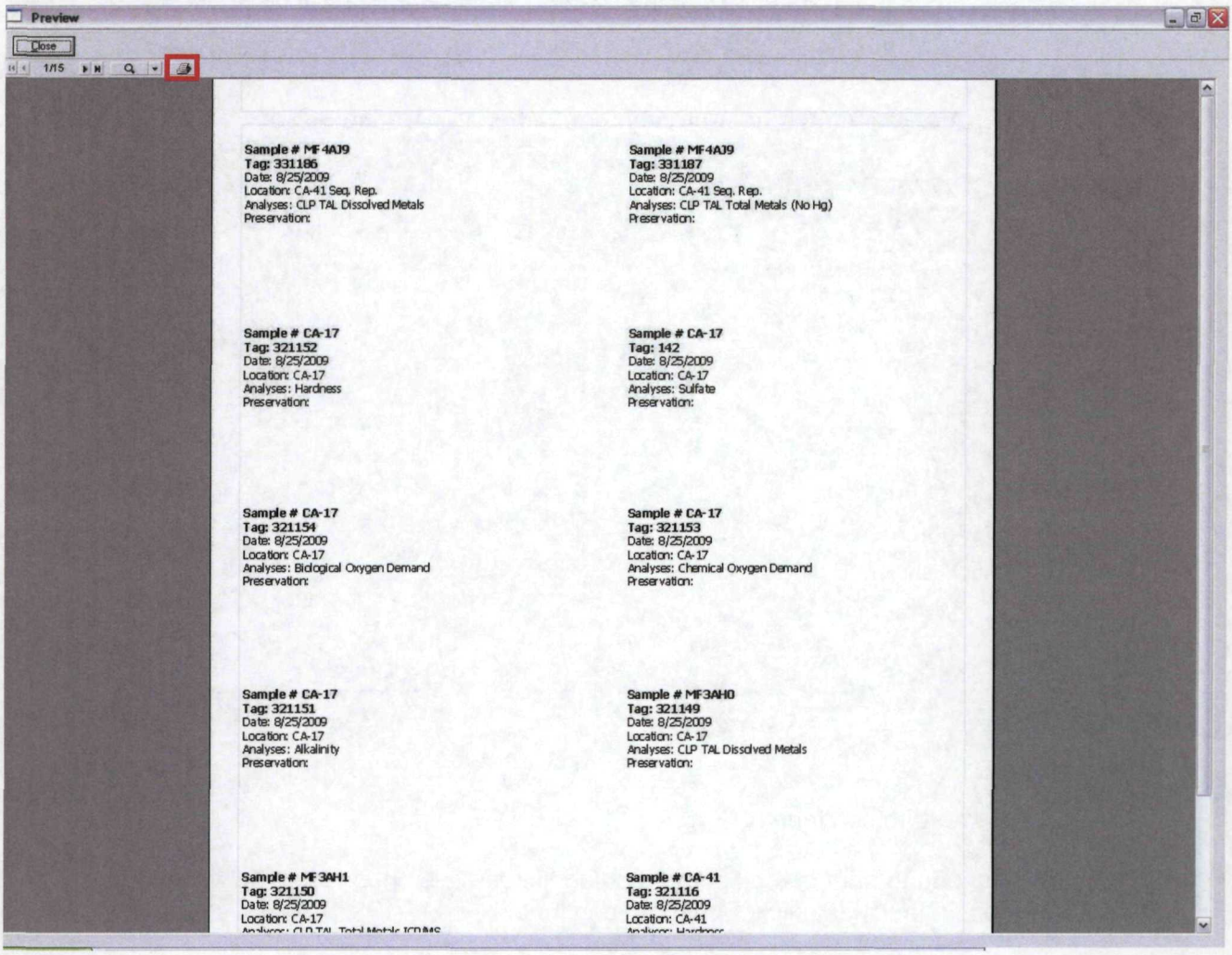


8. Click '**Next**' to continue.

9. If you need to print on half a sheet of labels, use this option to select which label to print on first. Otherwise, click '**Finish**' to continue.



10. A preview of the labels to be printed is displayed.



11. Click on the Printer icon on the top menu bar to print the labels.

Chain of Custody

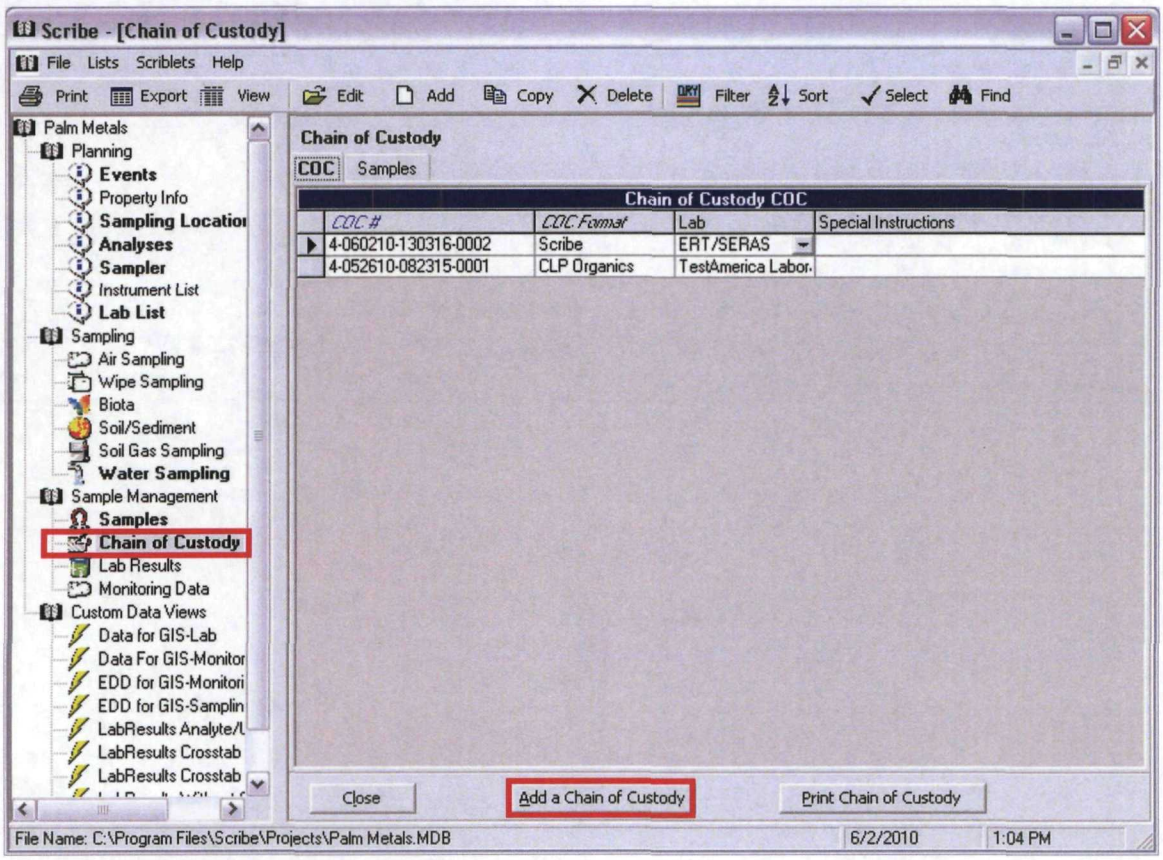
A new feature in Scribe to support CLP sampling is the COC Format for the Chain of Custody. The COC Format option modifies the COC form to adhere to COC standards and requirements. It also controls what samples can be assigned to the COC. For example, Samples with Inorganics analyses can only be assigned to the CLP Inorganics format on the COC.

Note: After submitting samples to the CLP labs, it is recommended that users request the labs to return lab results in electronic format i.e. a spreadsheet (.xls) or a comma-separated text (.csv). Scribe has a Custom Import feature that will import lab result data and marry them up with the sampling data. This effectively eliminates transcription errors and reduces data processing time. See the "Scribe Manual Advanced Part III" for importing details.

Create COC and Assign Samples

To manage and print a Chain of Custody (COC), a COC needs to be created and then samples have to be assigned to the COC:

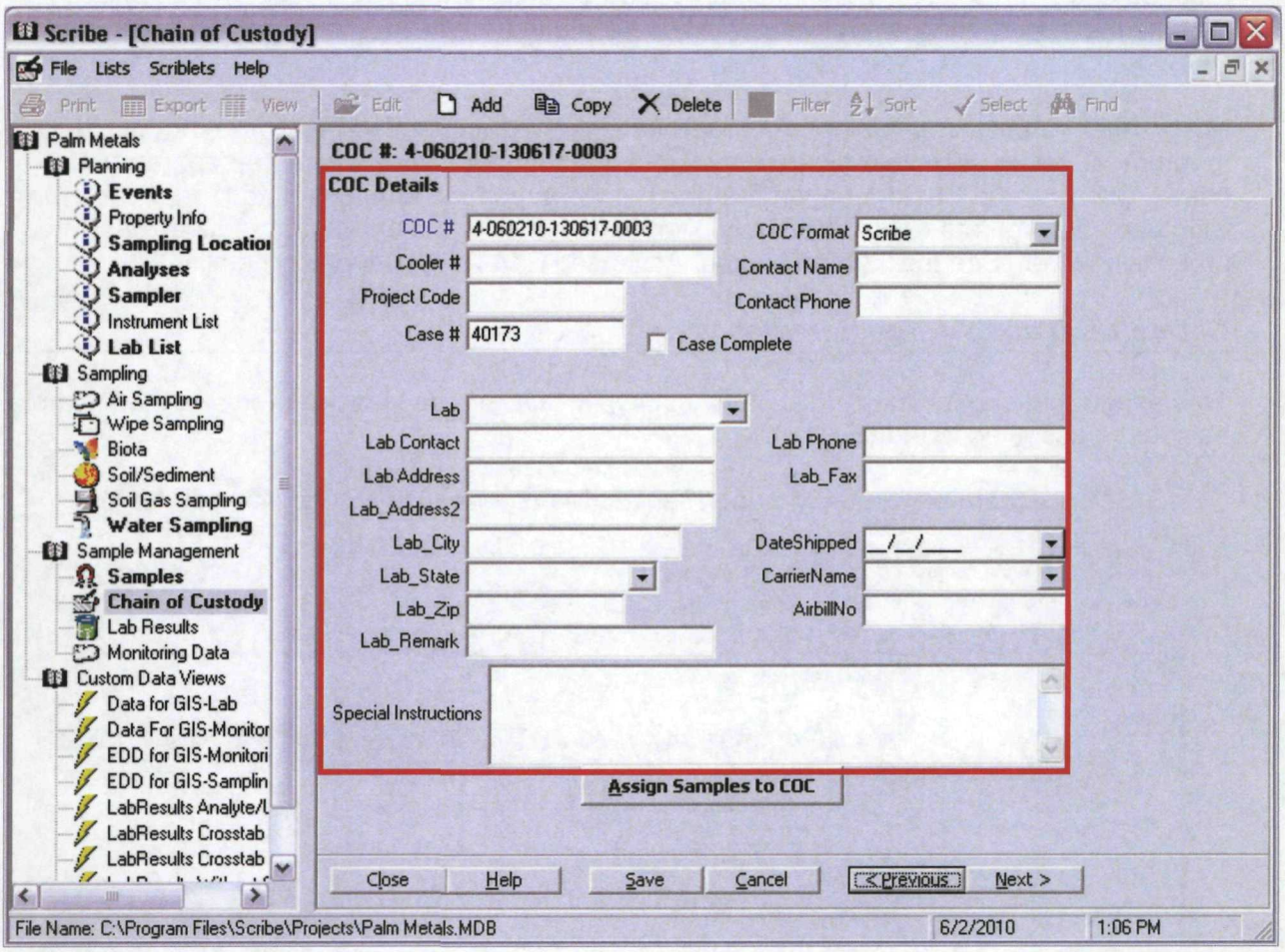
1. Select '**Chain of Custody**' under Sample Management in the left Navigation Pane.



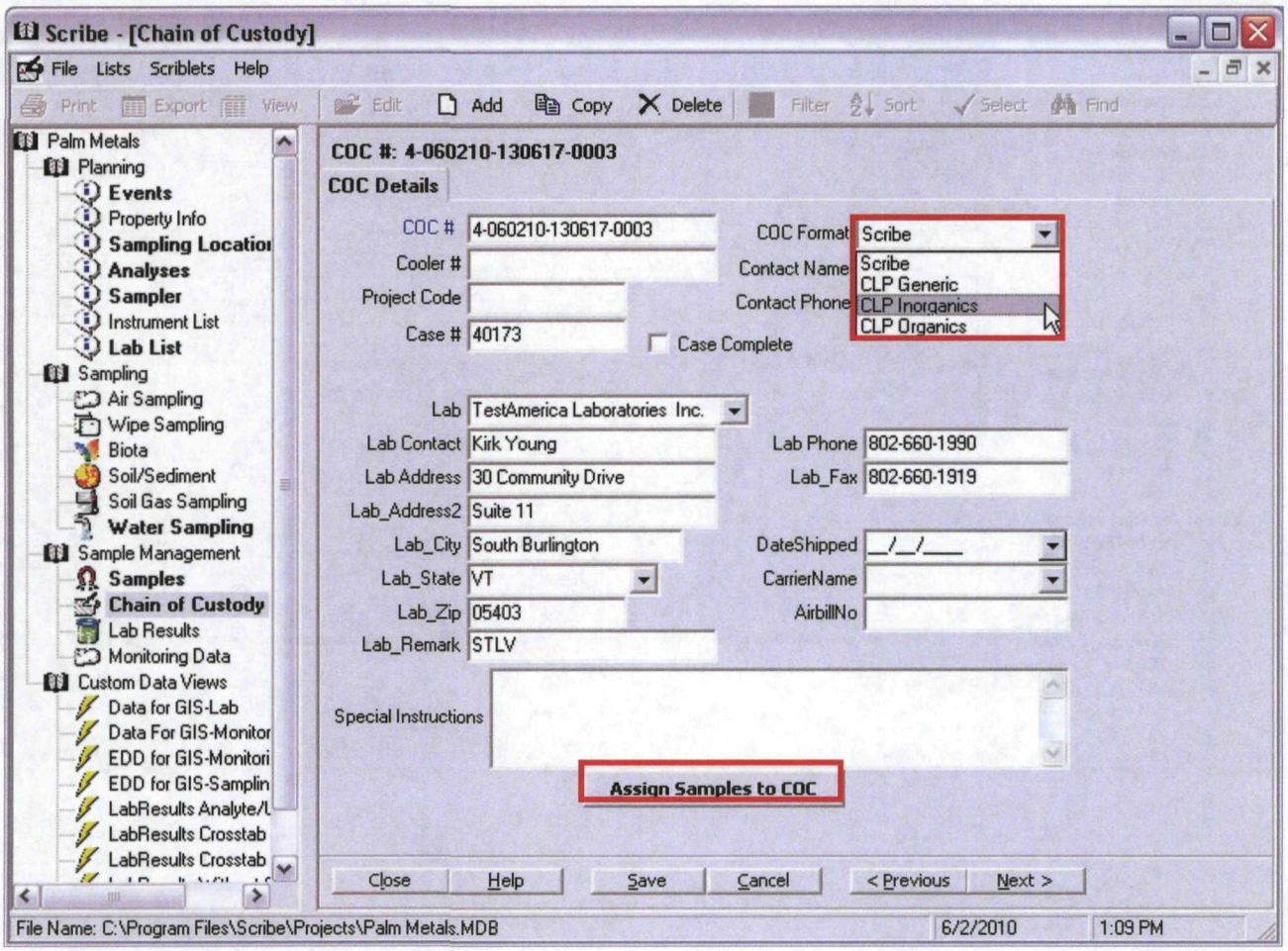
2. Click the '**Add a Chain of Custody**' button on the bottom of the window.

3. The "**COC Details**" screen is displayed.

4. Complete the form by entering other fields such as the **Case #, Cooler #, Lab, and Lab Phone**.

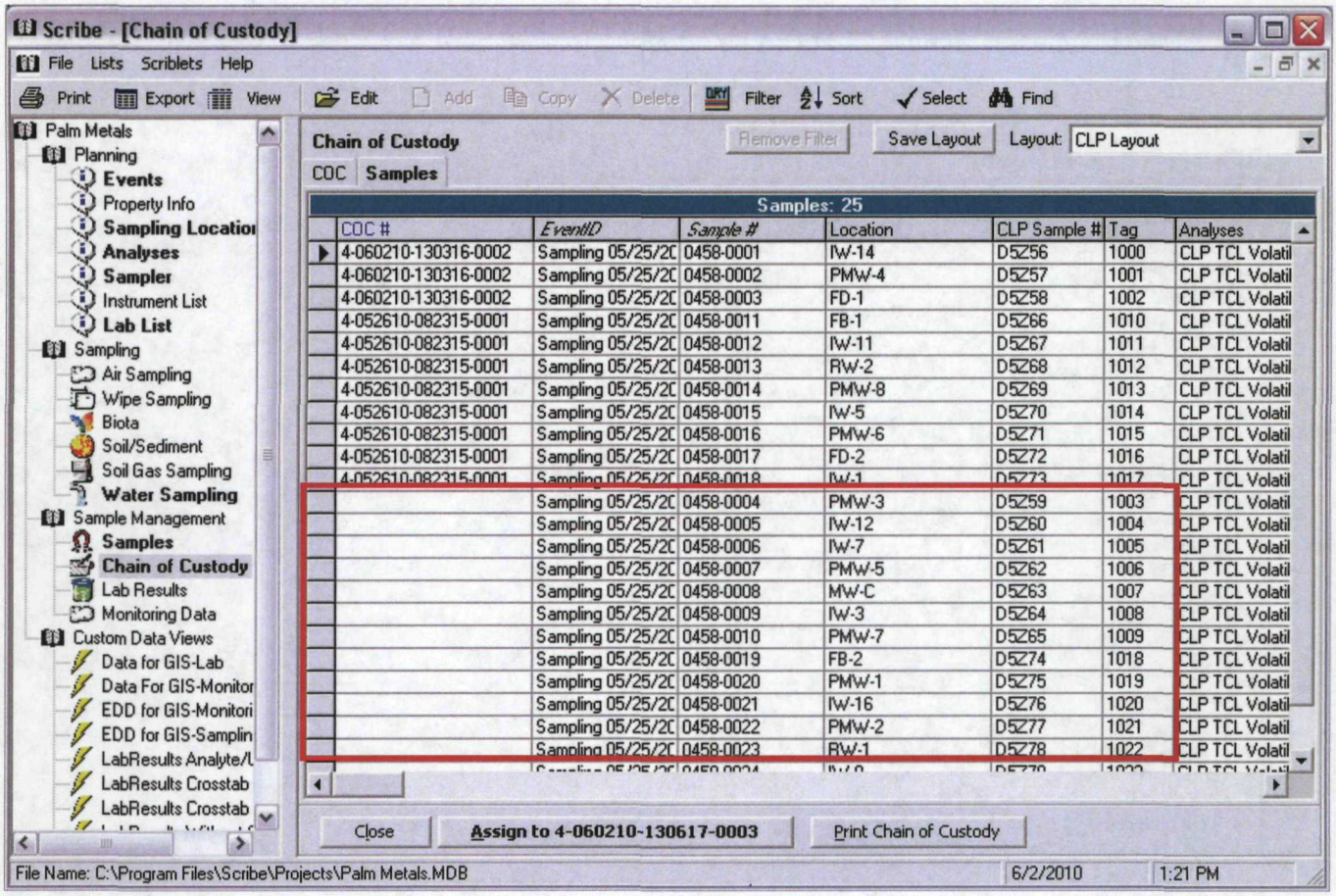


5. Select the appropriate **COC Format** based on the type of COC Samples you are packing. For example, if you are creating a COC for Inorganics, select COC Inorganics. The CLP Generic COC option should be used if you are submitting samples to a program other than CLP but one that requires a CLP/F2L type COC for generating CLP type XML files. Based on the format setting you select, the system will filter for only those types of samples that can be added to this COC.



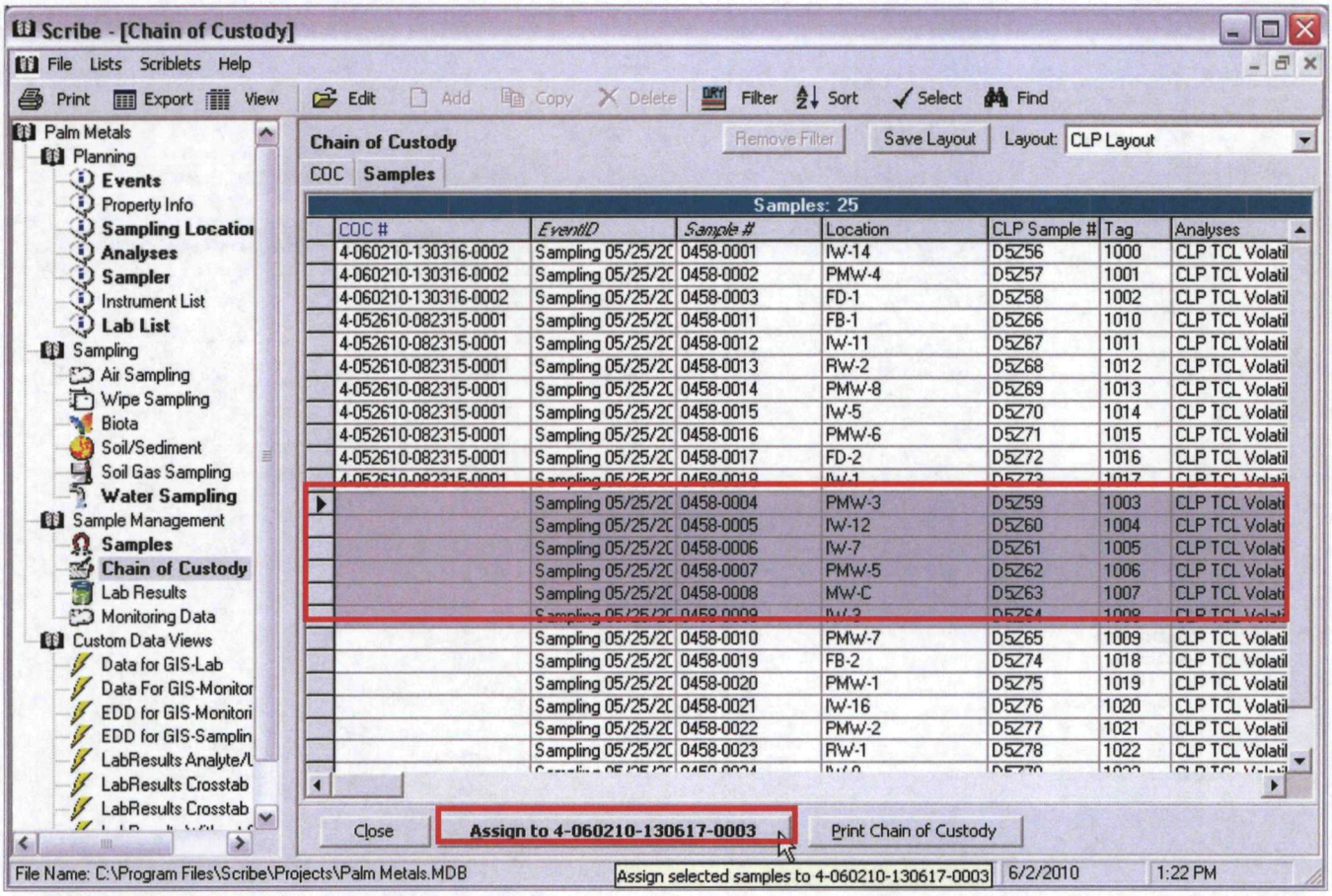
6. Click '**Assign Samples to the COC**' to continue.

7. The "**Chain of Custody Samples**" screen appears. Samples that have not been assigned to a chain are displayed at the bottom of the list.

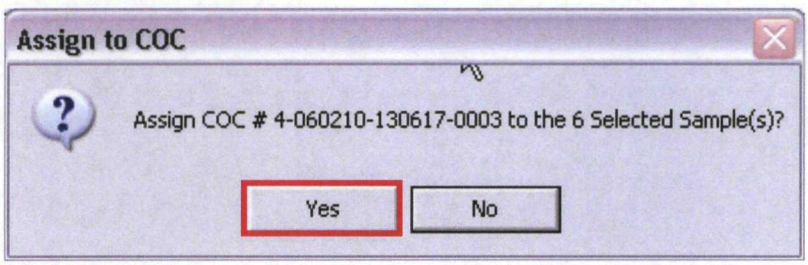


8. Highlight the samples to assign to the new Chain of Custody. Highlight multiple samples by holding down the Shift key or Ctrl key while clicking on the first column before COC# of the samples you wish to assign to the COC.

9. Click the '**Assign to...**' button on the bottom of the window to assign the samples to the Chain of Custody.



10. You will be prompted to confirm. Click '**Yes**' to assign the selected samples to the COC.

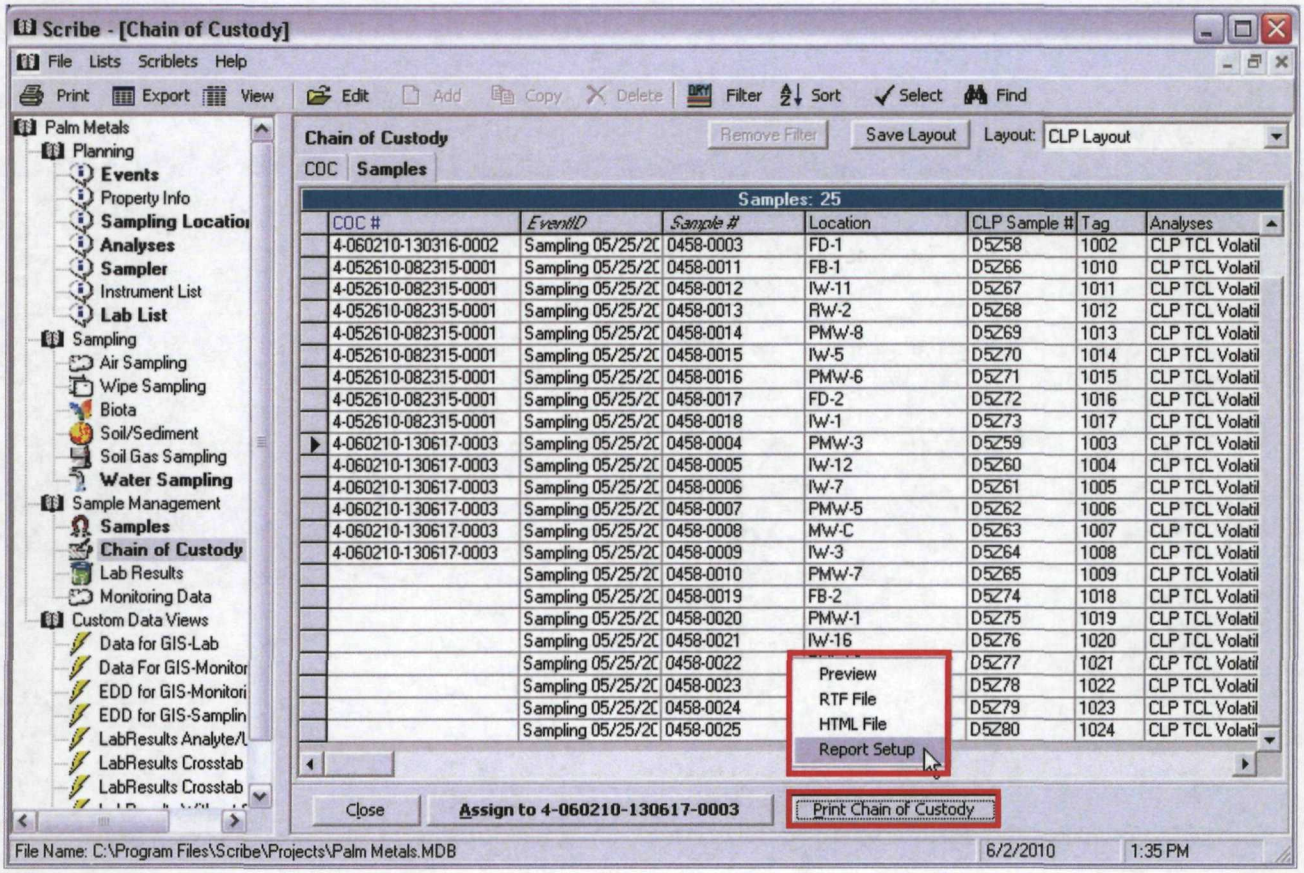


11. You are now ready to configure and print your COC.

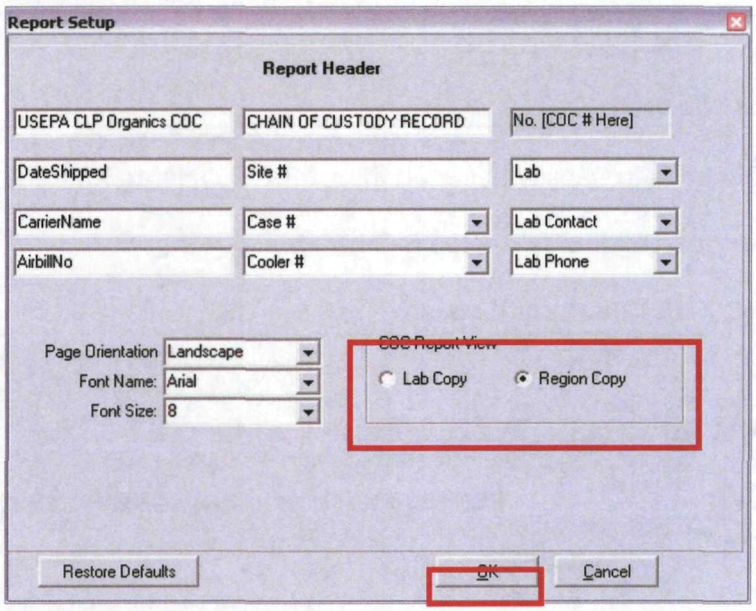
Configure and Print COC

To configure and print a COC:

1. Click the '**Print Chain of Custody**' button.
2. Then select '**Report Setup**'.

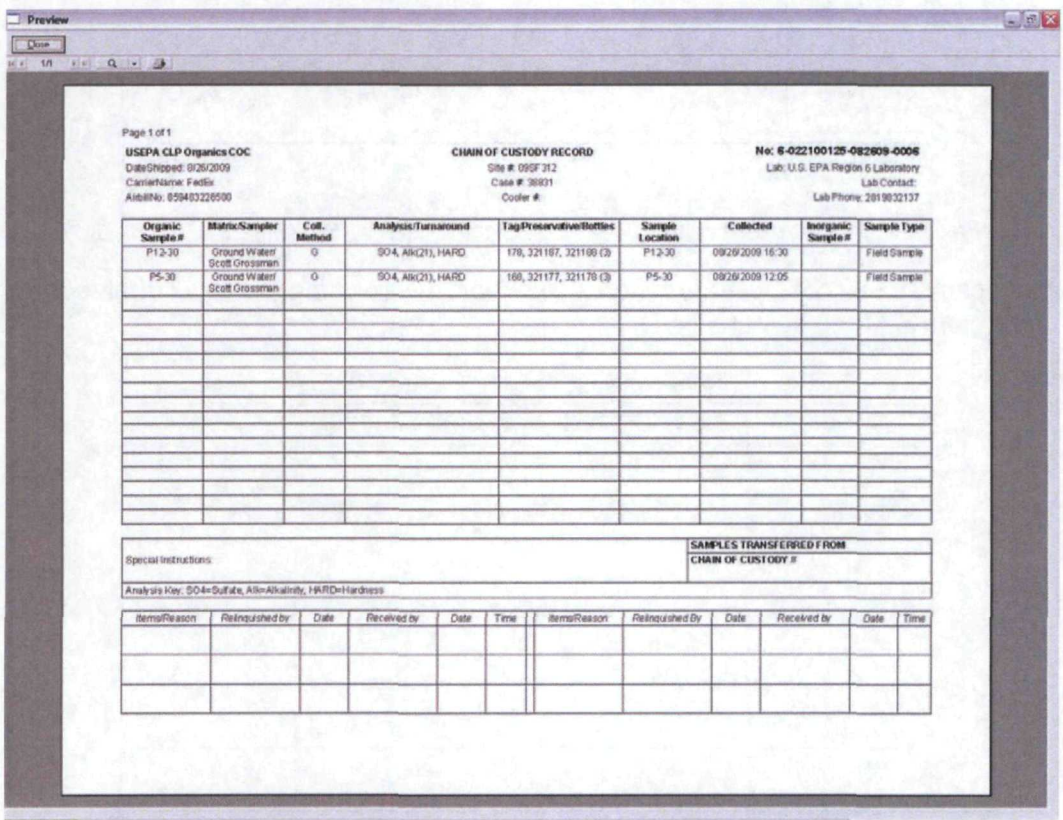


3. The Report Header settings are displayed.



4. The COC Report View (Lab or Region Copy) can also be selected.

5. Click '**OK**' to preview and print the Chain of Custody.

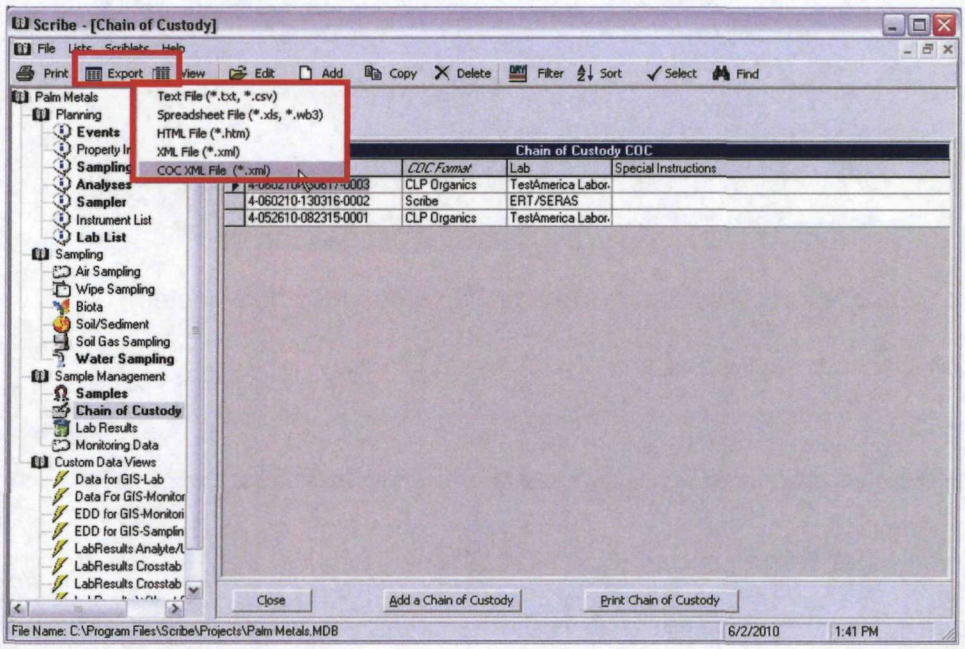


Export to XML File

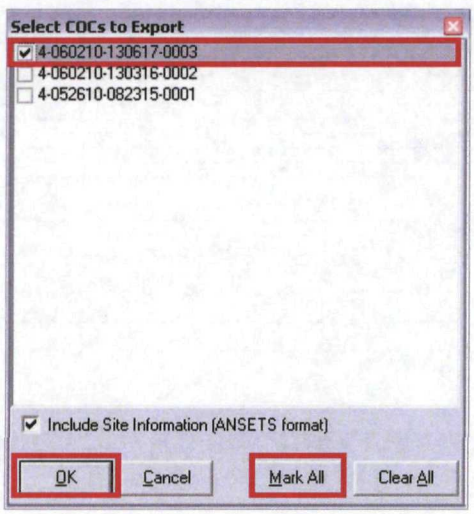
Export COC to XML

A new feature in Scribe is the ability to export the CLP COCs to an XML file. To export:

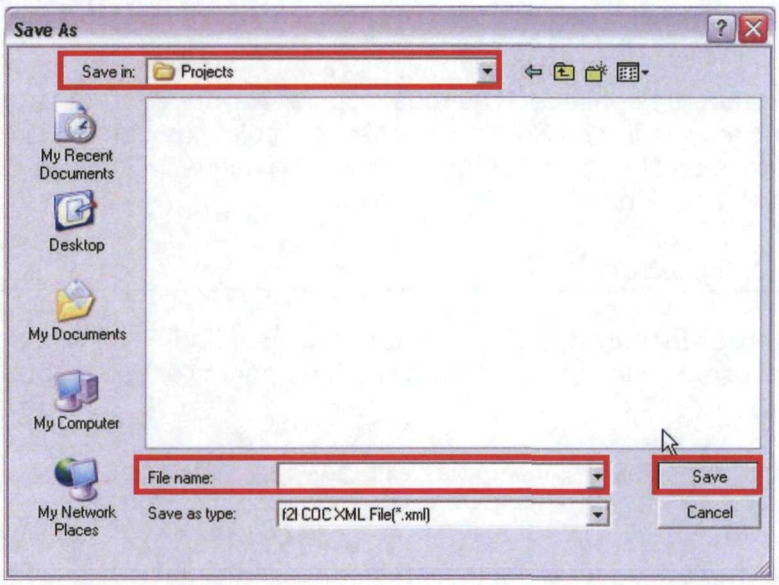
1. Click the '**Export**' button on the top menu bar.
2. Select '**COC XML File (*.xml)**' option.



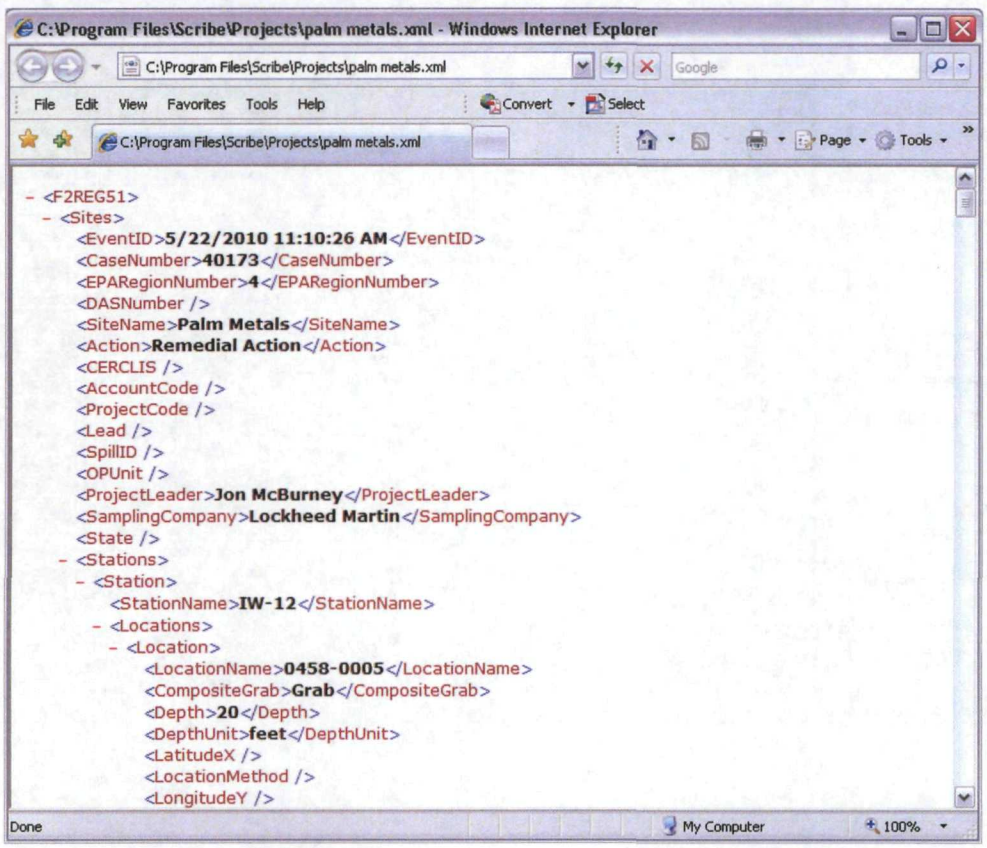
3. Select the Chain of Custody records to export by checking the individual records or click **'Mark All'** to select all COCs.



4. Select your location and provide a filename and click '**Save**'.



5. The XML file will open in Windows Internet Explorer while the file is created and saved.



REPORTING

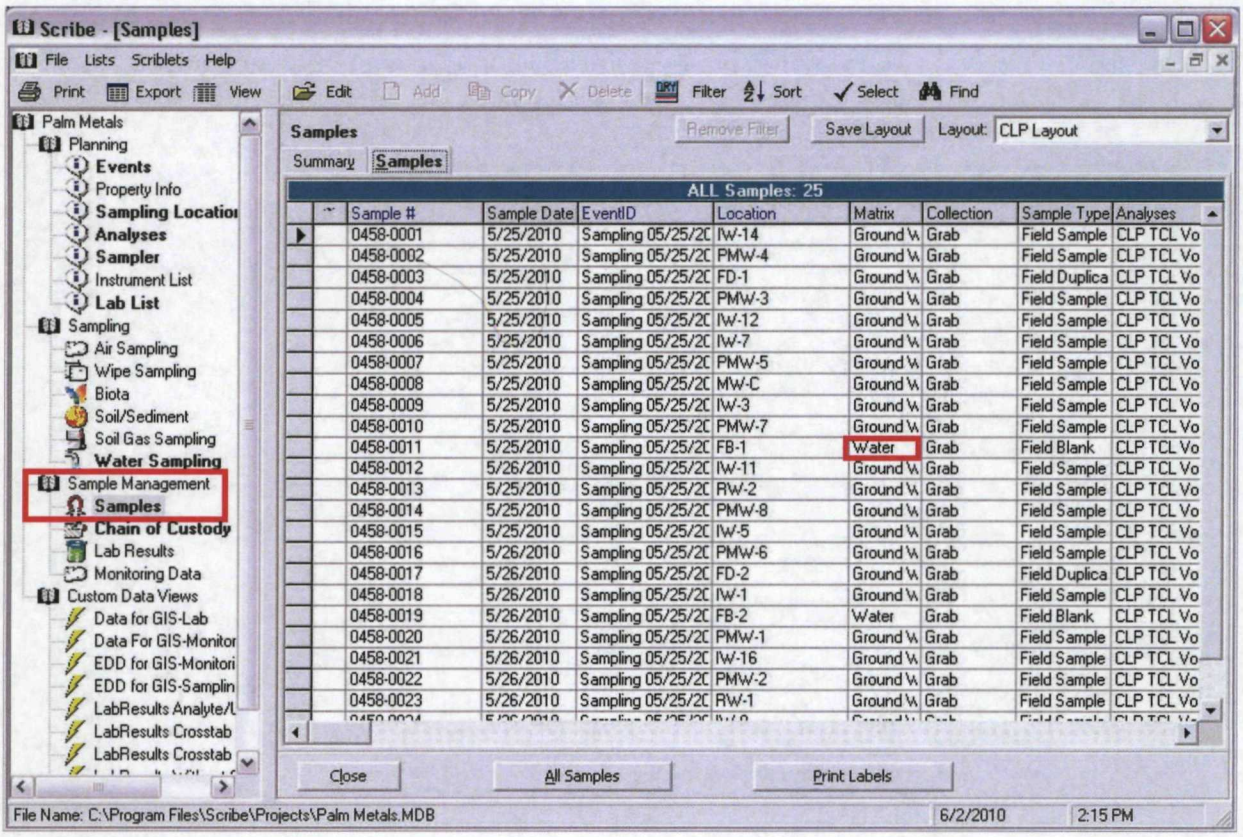
Scribe has flexible reporting options. The most popular way to report out from Scribe is to manipulate the grid view in the All Samples screen to display the data you wish to report. Then export the grid data to an file type that fits your reporting needs. File types include .txt, .csv, .xls, .htm, .xml, .kml, and .kmz.

Find, Filter and Sort

Scribe has built-in user-friendly querying functions such as Find, Filter and Sort. These functions are most useful when you are searching for a particular subset of data that meets one or more criteria.

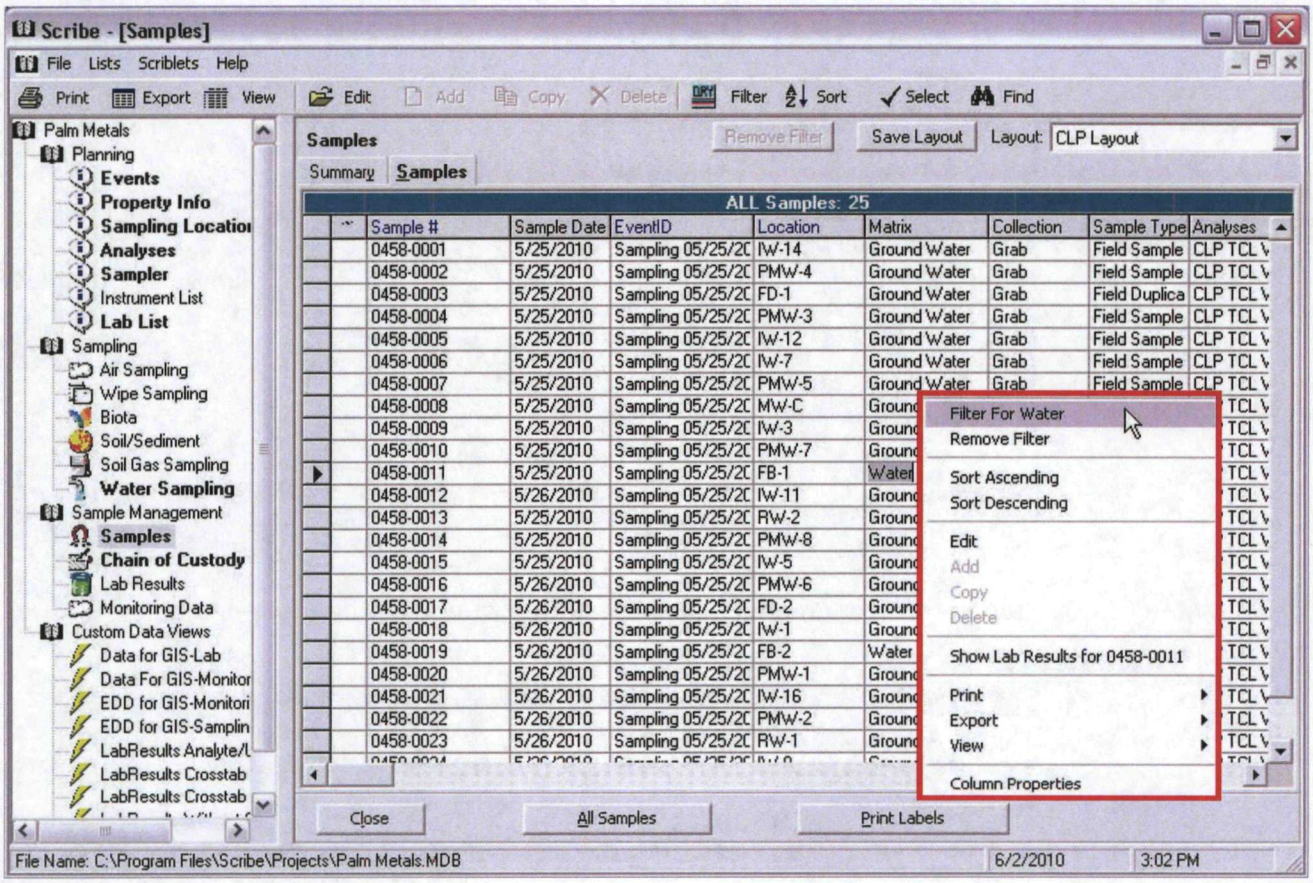
For example, to find and filter for all samples with a Water matrix or Sort ascending/descending:

1. Click on **'Samples'** under Sample Management in the left Navigation bar.



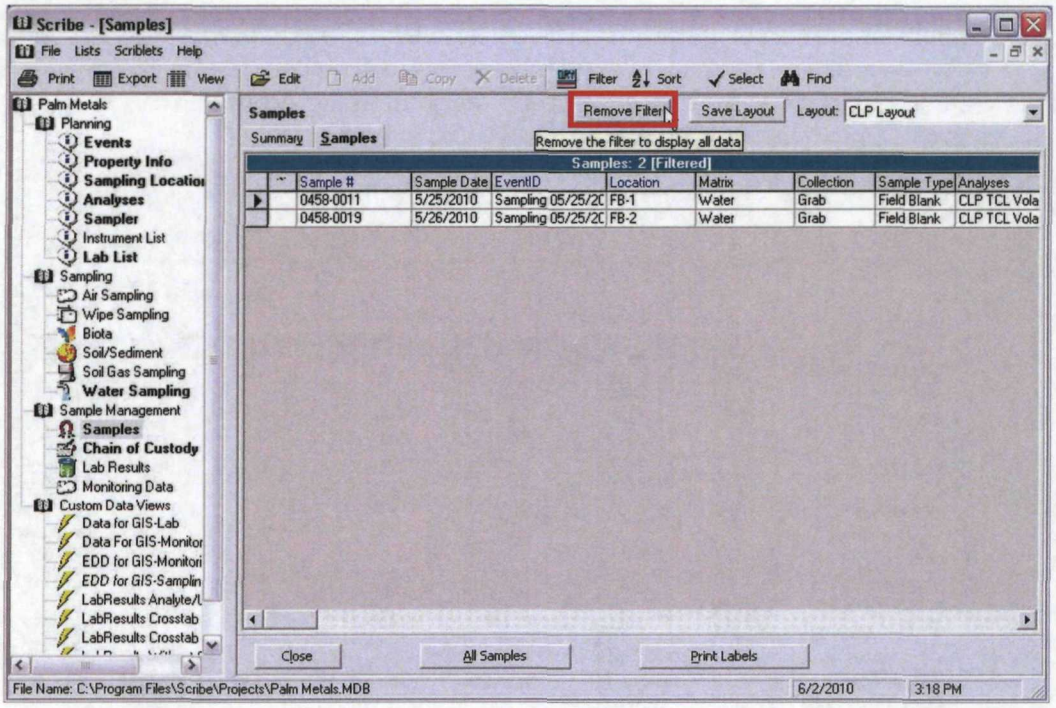
2. To filter or sort on ONE criteria, RT-click on Water value in the Matrix column.

3. Select '**Filter for Water**' in the pop-up menu or select Sort.

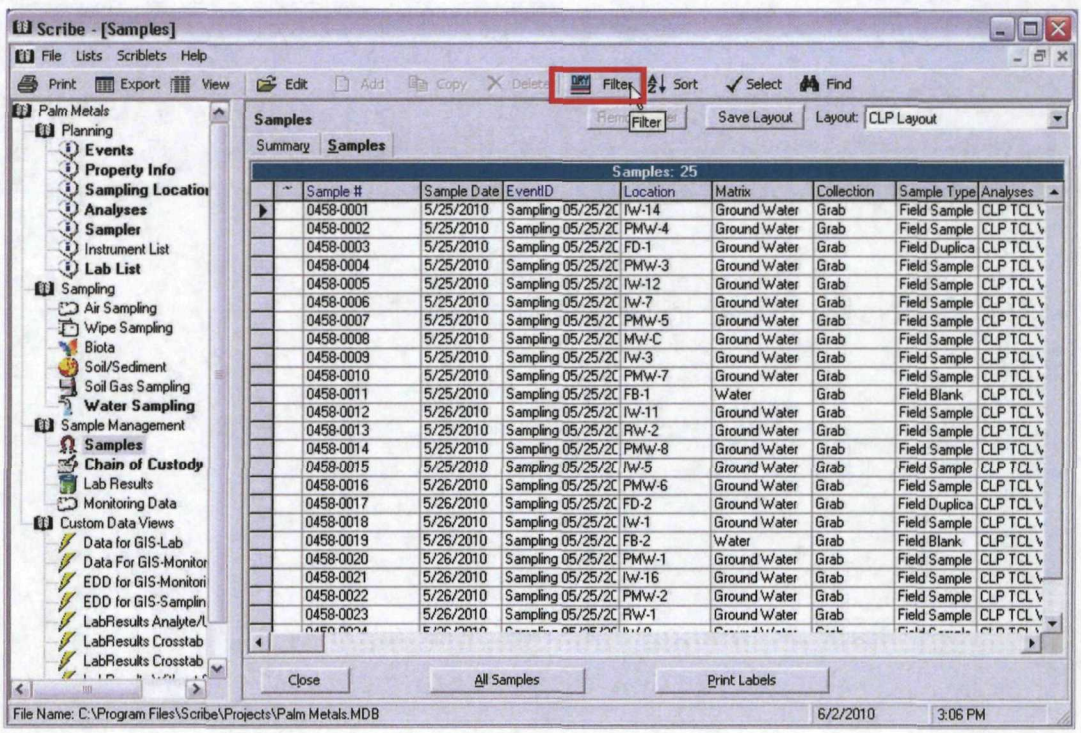


All records that have Water in the Matrix field are displayed.

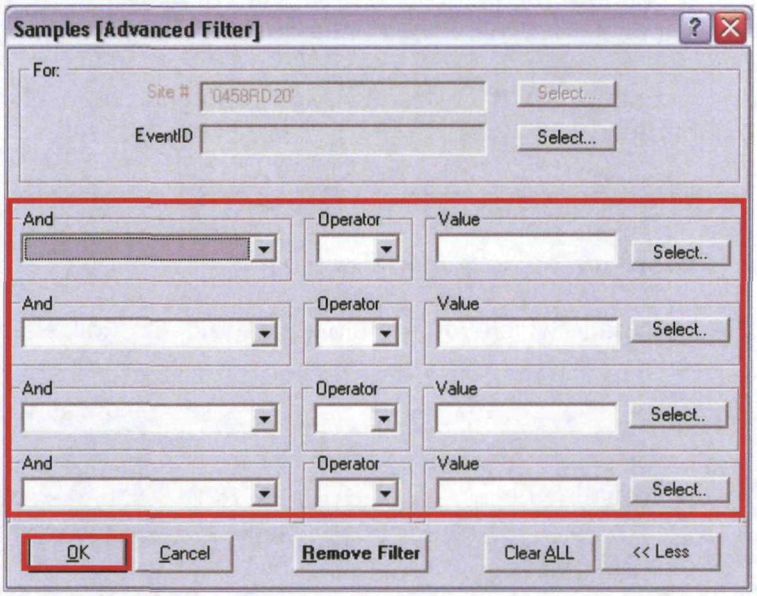
4. To remove the applied filter, click the **'Remove Filter'** button at the top of the screen.



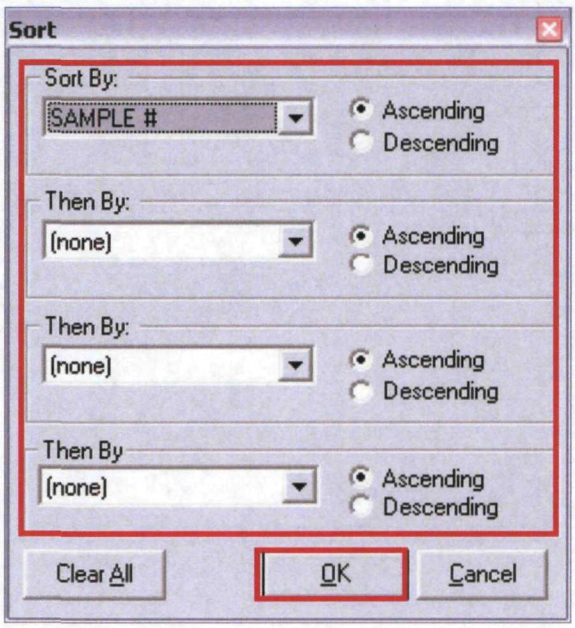
5. To filter on multiple criteria, select the **'Filter'** button on the top menu bar.



6. The Advanced Filter window is displayed. Input the criteria that for your search and click **'OK'** to apply the filter.



7. The Advanced **Sort** button also provides multi-tiered sorting options for sorting on more than one criteria.



Export

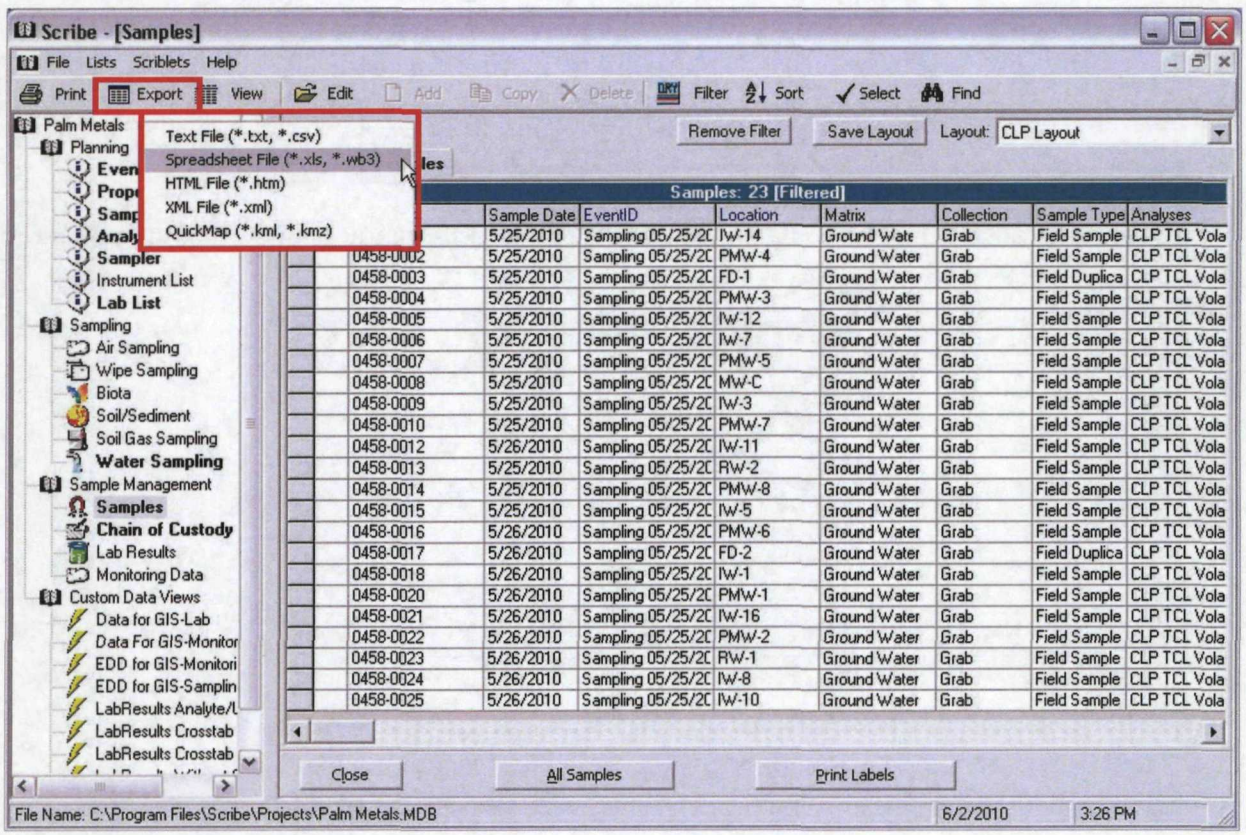
The Scribe grid view does not display every field in Scribe. Select fields are displayed by default and the user can turn on/off the columns. Turn on/off columns as described in the Sample Management section of this document to manipulate the data that is displayed.

After your grid view contains the data necessary for reporting purposes, the user can export the grid view to a third-party file type.

To export the grid view:

1. Click on **'Export'** button on the top menu bar.

2. Select the file type to which you wish to save the data. For example, Spreadsheet (.xls).



	Sample Date	EventID	Location	Matrix	Collection	Sample Type	Analyses
0458-0002	5/25/2010	Sampling 05/25/2(	IW-14	Ground Wate	Grab	Field Sample	CLP TCL Vola
0458-0003	5/25/2010	Sampling 05/25/2(	PMW-4	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0004	5/25/2010	Sampling 05/25/2(	FD-1	Ground Water	Grab	Field Duplica	CLP TCL Vola
0458-0005	5/25/2010	Sampling 05/25/2(	PMW-3	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0006	5/25/2010	Sampling 05/25/2(	IW-12	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0007	5/25/2010	Sampling 05/25/2(	IW-7	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0008	5/25/2010	Sampling 05/25/2(	PMW-5	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0009	5/25/2010	Sampling 05/25/2(	MW-C	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0010	5/25/2010	Sampling 05/25/2(	IW-3	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0012	5/26/2010	Sampling 05/25/2(	PMW-7	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0013	5/25/2010	Sampling 05/25/2(	IW-11	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0014	5/25/2010	Sampling 05/25/2(	RW-2	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0015	5/25/2010	Sampling 05/25/2(	PMW-8	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0016	5/26/2010	Sampling 05/25/2(	IW-5	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0017	5/26/2010	Sampling 05/25/2(	PMW-6	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0018	5/26/2010	Sampling 05/25/2(	FD-2	Ground Water	Grab	Field Duplica	CLP TCL Vola
0458-0020	5/26/2010	Sampling 05/25/2(	IW-1	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0021	5/26/2010	Sampling 05/25/2(	PMW-1	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0022	5/26/2010	Sampling 05/25/2(	IW-16	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0023	5/26/2010	Sampling 05/25/2(	PMW-2	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0024	5/26/2010	Sampling 05/25/2(	RW-1	Ground Water	Grab	Field Sample	CLP TCL Vola
0458-0025	5/26/2010	Sampling 05/25/2(	IW-8	Ground Water	Grab	Field Sample	CLP TCL Vola
	5/26/2010	Sampling 05/25/2(	IW-10	Ground Water	Grab	Field Sample	CLP TCL Vola

3. You will be prompted to select the destination and name the file.

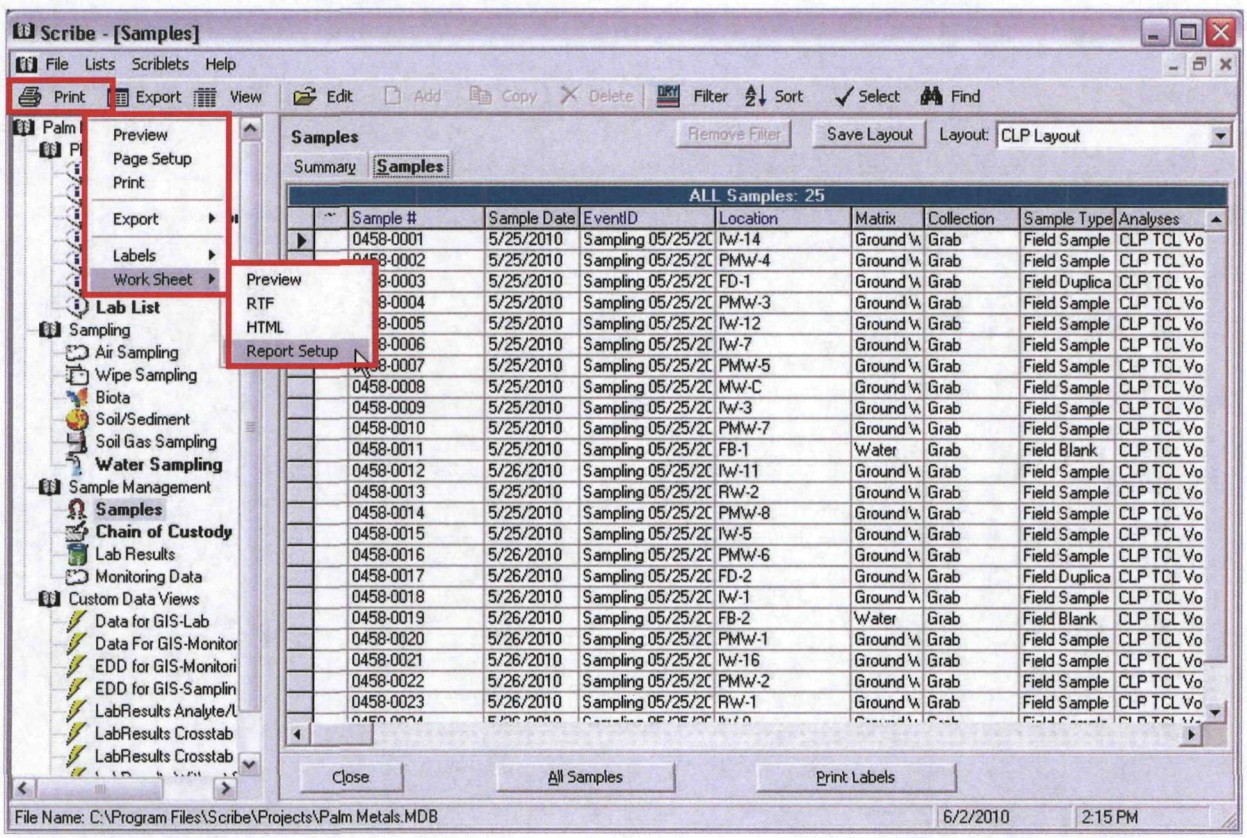
4. The file will open in the external application if it is installed on your computer. For example, if you selected Spreadsheet, Excel will open with the grid data.

Worksheet Reports

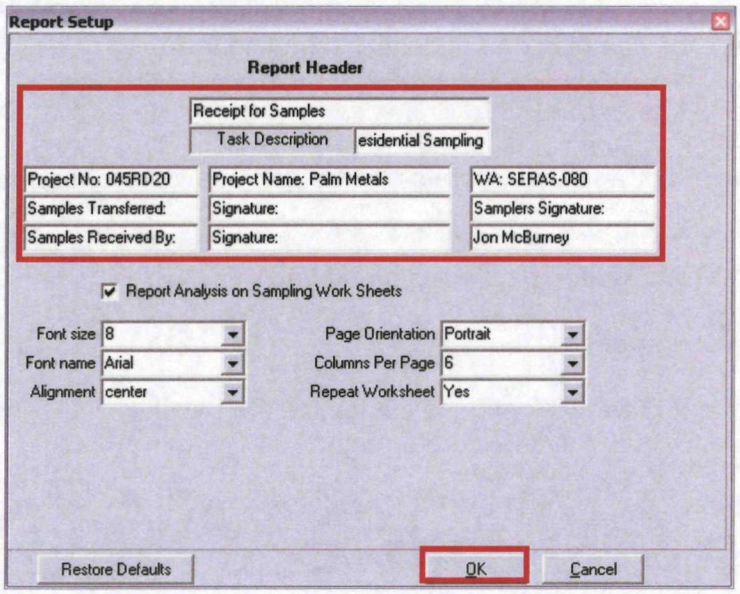
Scribe provides a generic worksheet report that allows the user to customize the Header of the report to suit their needs. This option can be used to customize a Samples Report that could be used as a Receipt for Samples on residential sampling tasks.

To generate the worksheet report:

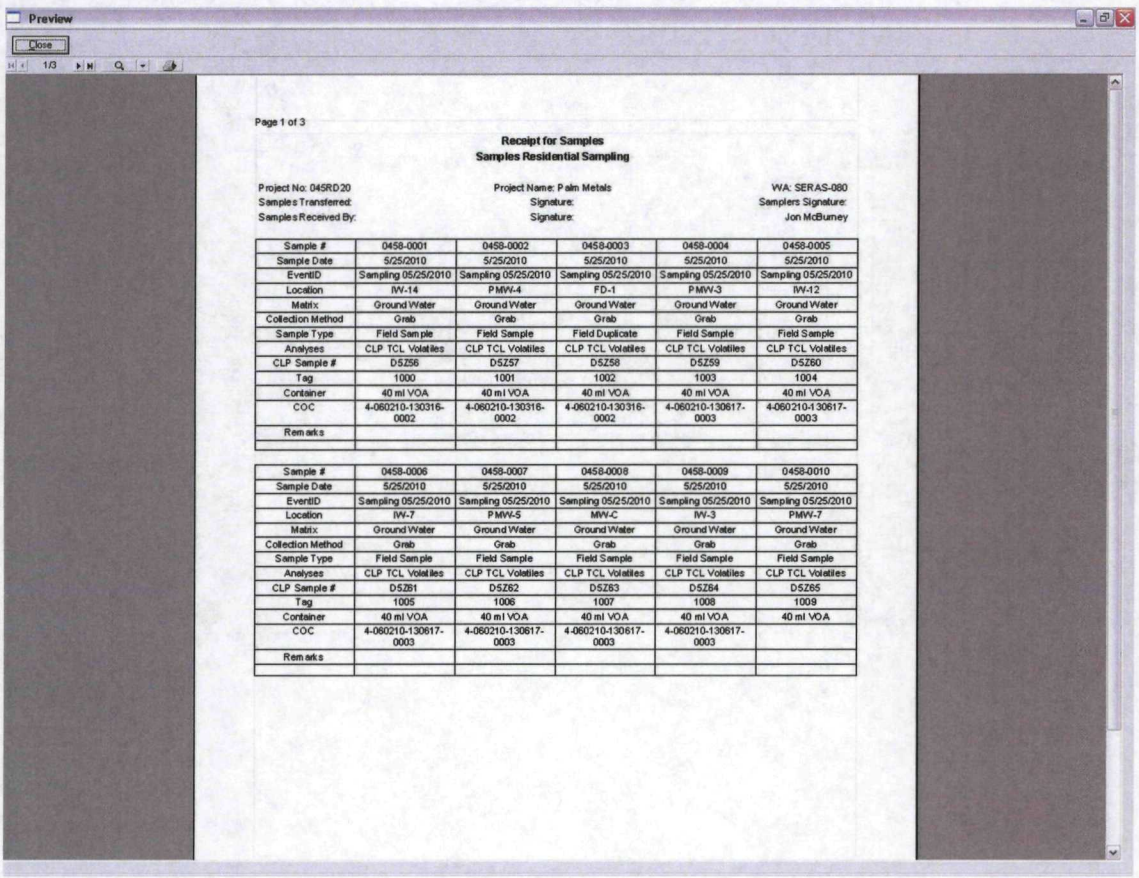
1. Use the Find, Filter and Sort options and Column Views to display the data you want to report.
2. Click on the **'Print'** button on the top menu bar.
3. Select the **'Worksheet'** option.
4. Select the **'Report Setup'** option to customize the Header. RTF and HTML will print the worksheet data to the selected format.



5. Configure the Report Header fields to reflect the information that will be displayed at the top of the report.



6. Click **'OK'** and the report is generated.



Sample #	0458-0001	0458-0002	0458-0003	0458-0004	0458-0005
Sample Date	5/25/2010	5/25/2010	5/25/2010	5/25/2010	5/25/2010
EventID	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010
Location	IW-14	PMW-4	FD-1	PMW-3	IW-12
Matrix	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Collection Method	Grab	Grab	Grab	Grab	Grab
Sample Type	Field Sample	Field Sample	Field Duplicate	Field Sample	Field Sample
Analyses	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles
CLP Sample #	D5Z56	D5Z57	D5Z58	D5Z59	D5Z60
Tag	1000	1001	1002	1003	1004
Container	40 ml VOA	40 ml VOA	40 ml VOA	40 ml VOA	40 ml VOA
COC	4-060210-130316-0002	4-060210-130316-0002	4-060210-130316-0002	4-060210-130617-0003	4-060210-130617-0003
Remarks					

Sample #	0458-0006	0458-0007	0458-0008	0458-0009	0458-0010
Sample Date	5/25/2010	5/25/2010	5/25/2010	5/25/2010	5/25/2010
EventID	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010	Sampling 05/25/2010
Location	IW-7	PMW-5	MW-C	IW-3	PMW-7
Matrix	Ground Water	Ground Water	Ground Water	Ground Water	Ground Water
Collection Method	Grab	Grab	Grab	Grab	Grab
Sample Type	Field Sample	Field Sample	Field Sample	Field Sample	Field Sample
Analyses	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles
CLP Sample #	D5Z61	D5Z62	D5Z63	D5Z64	D5Z65
Tag	1005	1006	1007	1008	1009
Container	40 ml VOA	40 ml VOA	40 ml VOA	40 ml VOA	40 ml VOA
COC	4-060210-130617-0003	4-060210-130617-0003	4-060210-130617-0003	4-060210-130617-0003	
Remarks					

FIELD OPERATING PROCEDURE NO. 5

Site Logbook

I. Purpose

General guidelines are provided for keeping a site logbook.

II. Scope

The site logbook is a controlled document that records all major onsite activities during a remedial action. At a minimum, the following activities/events should be recorded in the site logbook:

- Arrival/departure of site visitors
- Weather conditions
- Arrival/departure of equipment
- Calibration notes
- Field parameter measurements
- Start or completion of sampling activities, borehole/trench/monitoring, well installation, etc.
- Health and Safety issues—note that the project Health and Safety Plan (HSP) specifies all documentation requirements

The site logbook becomes part of the permanent site file. Because information contained in the site logbook may be admitted as evidence in cost recovery or other legal proceedings, it is critical that this document be properly maintained.

III. Equipment and Materials

Bound notebook with consecutively numbered pages that cannot be removed

IV. Procedures and Guidelines

1. Dedicated site logbook(s) is maintained for each site
2. Site logbook is initiated at the start of the first on-site activity
3. Site logbook cover contains the following information in indelible ink:
   - Project name and EPA Work Assignment Number
   - Project Number

- Site Manager's Name
- Sequential Book Number
- Start Date
- End Date

4. Entries are made every day that on-site activities occur
5. At the beginning of each day, the following information must be recorded:
   - Date
   - Start time
   - Weather conditions
   - List all personnel present
   - List all visitors present
   - List topics discussed at health and safety meetings and attendees (for complete list, see HSP)
6. Record summary of daily site activities and level of personal protection required
7. Refer to other project notebooks being kept onsite (e.g., sample logbook, geologist's notebook, health and safety officer's notebook, etc.).
8. Record site measurements and equipment use in site logbook or reference logbook where this information is recorded.
9. All entries should be made in ink. No erasures are permitted. Incorrect entries should be crossed out with a single strike mark and initialed.
10. All photographic documentation must be logged into the logbook with a full description of each record and its key points of interest. Video tape, slides, or photographs taken on site or at monitoring locations should be numbered to correspond to logbook entries. Photographic records should also include name of photographer, date, time, site location, site description, and weather conditions.

V. Attachments

None.

VI. Key Checks and Items

- Logbook is initiated with the first on-site activity
- Logbooks must be sequentially numbered without removable pages
- All site activities are recorded
- Entries must be made daily

FIELD OPERATING PROCEDURE NO. 6

Decontamination of Personnel and Equipment

I. Purpose

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

- Distilled water
- 2.5-percent (W/W) Alconox®, Liquinox®,or equivalent phosphate-free detergent and water solution
- 10-percent methanol solution (DO NOT USE ACETONE)
- Large plastic pails or tubs for Alconox®, Liquinox®,or equivalent and water, scrub brushes, squirt bottles for detergent solution, methanol and water, resealable plastic bags and sheets
- Pesticide grade methanol
- DOT approved 55-gallon drum for disposal of waste
- Unpowdered chemical-resistant gloves
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

Personnel Decontamination

To be performed after the completion of tasks whenever the potential for contamination exists, and also upon leaving the exclusion zone.

1. Wash boots in detergent solution, then rinse with water. If disposable latex booties are worn over boots in the work area, remove and discard into a DOT-approved 55-gallon drum.
2. Remove and discard outer chemical-resistant gloves into a DOT-approved 55-gallon drum.
3. Remove disposable coveralls ("Tyveks") and discard into a DOT-approved 55-gallon drum.
4. Remove respirator (if worn).

5. Remove inner gloves and discard.
6. At the end of the work day, shower entire body, including hair, either at the work site or at home.
7. Sanitize respirator if worn.

Sampling Equipment Decontamination—Groundwater Sampling Pumps

Sampling pumps are decontaminated after each use as follows:

1. Wear unpowdered chemical-resistant gloves.
2. Spread plastic on the ground to prevent hoses from touching the ground.
3. Turn off the pump after sampling. Remove the pump from the well, and place it in a decontamination sleeve/tube, making sure that any tubing does not touch the ground.
4. Turn the pump back on, and pump 1 gallon of detergent solution through the sampling pump.
5. Rinse with 1 gallon of 10-percent isopropyl alcohol solution pumped through the pump. (DO NOT USE ACETONE).
6. Rinse with 1 gallon of potable water.
7. Rinse with 1 gallon of distilled water.
8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or put in new resealable plastic bag.
9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

Sampling Equipment Decontamination—Other Equipment

Reusable sampling equipment is decontaminated after each use as follows:

1. Wear unpowdered chemical-resistant gloves.
2. Rinse and scrub with potable water.
3. Wash all equipment surfaces that came into contact with the potentially contaminated soil/water with detergent solution.
4. Rinse with potable water.
5. Rinse with distilled water.
6. If equipment has come in contact with oil or grease, rinse the equipment with pesticide-grade methanol followed by pesticide-grade methanol (DO NOT USE ACETONE), and then distilled water.

7. Completely air dry or wipe dry with a clean paper towel. Wrap exposed areas with aluminum foil (shiny side out) or enclose equipment in clean plastic for transport and handling if equipment will not be used immediately.
8. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
9. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

Health and Safety Monitoring Equipment Decontamination

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with detergent solution, then a towel wet with alcohol solution, and finally two times with a towel wet with distilled water. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

Sample Container Decontamination

The outside of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedure is:

1. Wipe container with a paper towel dampened with detergent solution, or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.
2. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

Decontamination of Drilling Rigs and Equipment

Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Alconox® or Liquinox®
- Buckets
- Brushes
- Distilled water
- 10 percent isopropyl alcohol solution
- Methanol
- ASTM–Type II Reagent-Grade Water
- Aluminum foil

Drilling Rigs and Monitoring Well Materials

Before the onset of drilling, after each borehole, and before leaving the site, heavy equipment and machinery will be decontaminated using a phosphate-free detergent solution and high-pressure hot water at a designated area. The equipment shall then be rinsed with potable water. The steam cleaning area will be designed to contain

decontamination wastes and waste waters, and can be an HDPE-lined, bermed pad. A pumping system will be used to convey decontamination water from the pad to the drums.

Surface casings may be steam-cleaned in the field if they are exposed to contamination at the site before use.

Downhole Drilling Tools

Downhole tools will be decontaminated as described above (1) before the onset of drilling and (2) between boreholes. This will include rods, split spoons or similar samplers, coring equipment, auger bolts, augers, and casing.

Before the use of a sampling device such as a split-spoon sampler to collect soil samples for physical characterization or chemical analysis, the sampler shall be cleaned by scrubbing with a potable water/phosphate-free detergent solution, rinsing with potable water, and then rinsing with distilled water. If equipment has come in contact with oil or grease, rinse the equipment with methanol, and then distilled water.

V. Attachments

None.

VI. Key Checks and Items

1. Do not use acetone for decontamination.
2. Drum all contaminated rinsate.
3. Clean with solutions of Alconox®, Liquinox®, or equivalent phosphate-free detergent, isopropyl alcohol, and distilled water.

FIELD OPERATING PROCEDURE NO. 7

High-Volume Total Suspended Particulate Matter Sampling

I. Scope

This section describes procedures for sampling the ambient air for total suspended particulate matter (TSP). These samples will be collected using a high-volume TSP sampler equipped with a mass flow controller (MFC) system according to American Society for Testing and Materials (ASTM) Method D4096-82.

The particulate samples collected by this procedure will be analyzed for total mass of TSP. The mass in micrograms (μg) of the TSP or leach collected will be divided by the sample volume expressed as cubic meters at standard pressure and temperature (SCM) to give mass per standard volume expressed as μg/SCM.

II. Introduction

A high-volume TSP sampler draws a known volume of ambient air at a constant flow rate through a size-selective inlet and through one or more filters. Particles are then collected on the filter(s) during the specified 24-hour sampling period. Each sample filter is weighed before and after sampling to determine the net weight (mass) gain of the collected TSP sample. Sampling method, sampler calibrations, sampling procedures, laboratory procedures data reporting, and quality assurance procedures are presented in this section.

The total volume of air sampled is determined from the measured volumetric flow rate and the sampling time. The concentration of TSP in the ambient air is computed as the total mass of collected particles divided by the volume of air sampled. This sampled volume must be corrected to EPA standard conditions (25°C, 760 mmHg or 101 kPa), and the TSP measurement is expressed as micrograms per standard cubic meter (μg/std m^3).

Because air velocities are critical, maintaining the correct design flow rate through the inlet is important. This design flow rate is specified by the manufacturer.

The flow rate in a mass flow-controlled (MFC) system is actively sensed and controlled at some predetermined set point. Air is pulled through the filter into the intake of a blower and subsequently exits the sampler through an exit orifice, which facilitates measurement of the flow with a manometer or pressure recorder. The flow rate is controlled by an electronic mass-flow controller, which uses a flow sensor installed below the filter holder to monitor the mass flow rate and to control the speed of the motor accordingly. The controlled flow rate can be changed by an adjustment knob on the flow controller.

III. Basic Calibration Procedure for a Mass-Flow-Controlled Sampler Using an Orifice Transfer Standard

Introduction

TSP samples are calibrated before sampling commences and routinely throughout the sampling program as outlined below:

1. After a motor brush change or any repair work has been done to alter the speed of the motor
2. When a sampler has been moved
3. At least once a quarter or whenever the sampler has failed a performance audit or a QC flow check

Individual components of the sampling method must be calibrated to ensure data integrity because TSP concentration standards are not available for determining calibration relationships.

A high-volume TSP sampler essentially pulls a sample of a known volume of ambient air through a filter during a measured period of time and collects particulate mass on the filter. In order to establish ambient TSP concentrations, three independent determinations are made: air volume flow rate, sampling time and particulate mass.

The MFC sampler calibration procedure presented in this section relates known flow rates to the pressure in the exit orifice plenum. The known flow rates are determined by an orifice transfer standard that has been certified according to the procedure presented in *Quality Assurance Handbook for Air Pollution Measurement Items,* Volume II, EPA-600/4-77-027a. The exit orifice plenum is the area within the motor housing (below the motor unit) through which the air flows just before it is exhausted to the atmosphere through the exit orifice. This exit orifice plenum pressure is measured with an 8-inch oil manometer. Each sampler has its own dedicated manometer, which is mounted to the inside wall of the sampler housing a 4-inch continuous pressure (flow) recorder.

Mg (Dickson chart) is used for nonquantitative determination that the flow was constant and uninterrupted over the sample period. The flow recorder is connected in parallel with the manometer using a tee or "Y" tubing connection.

For this MFC calibration procedure, the following conditions are assumed:

- The high-volume TSP sampler is equipped with a mass-flow controller to control flow rate.
- The sampler flow rate is measured by measuring the exit orifice plenum pressure, using an oil manometer.
- The sampler inlet is designed to operate at an actual volumetric flow rate of 1.13 m^3/min, and the acceptable flow rate range is ± 10 percent of this value.
- The transfer standard for the flow rate calibration is an orifice device equipped with an integral variable-resistance valve. The pressure drop across the orifice is measured by an associated water or oil manometer.

- The sampler will be calibrated in actual volumetric flow rate units (Qa), and the orifice transfer standard is also calibrated in Qa.

Calibration Equipment

The following equipment should be available for field sampler calibration:

1. Orifice transfer standard with calibration traceable to NIST. The calibration certification papers will also be needed in order to calculate the flows for the transfer standard.
2. An associated water or oil manometer, with 0- to 16-inch range and a minimum scale division of 0.1 inch for measurement of the transfer standard's flow.
3. A water or oil manometer, with a 0- to 8-inch range and a minimum scale division of 0.1 inch for measurement of the sampler exit orifice plenum pressure. This manometer is found mounted on the sampler housing.

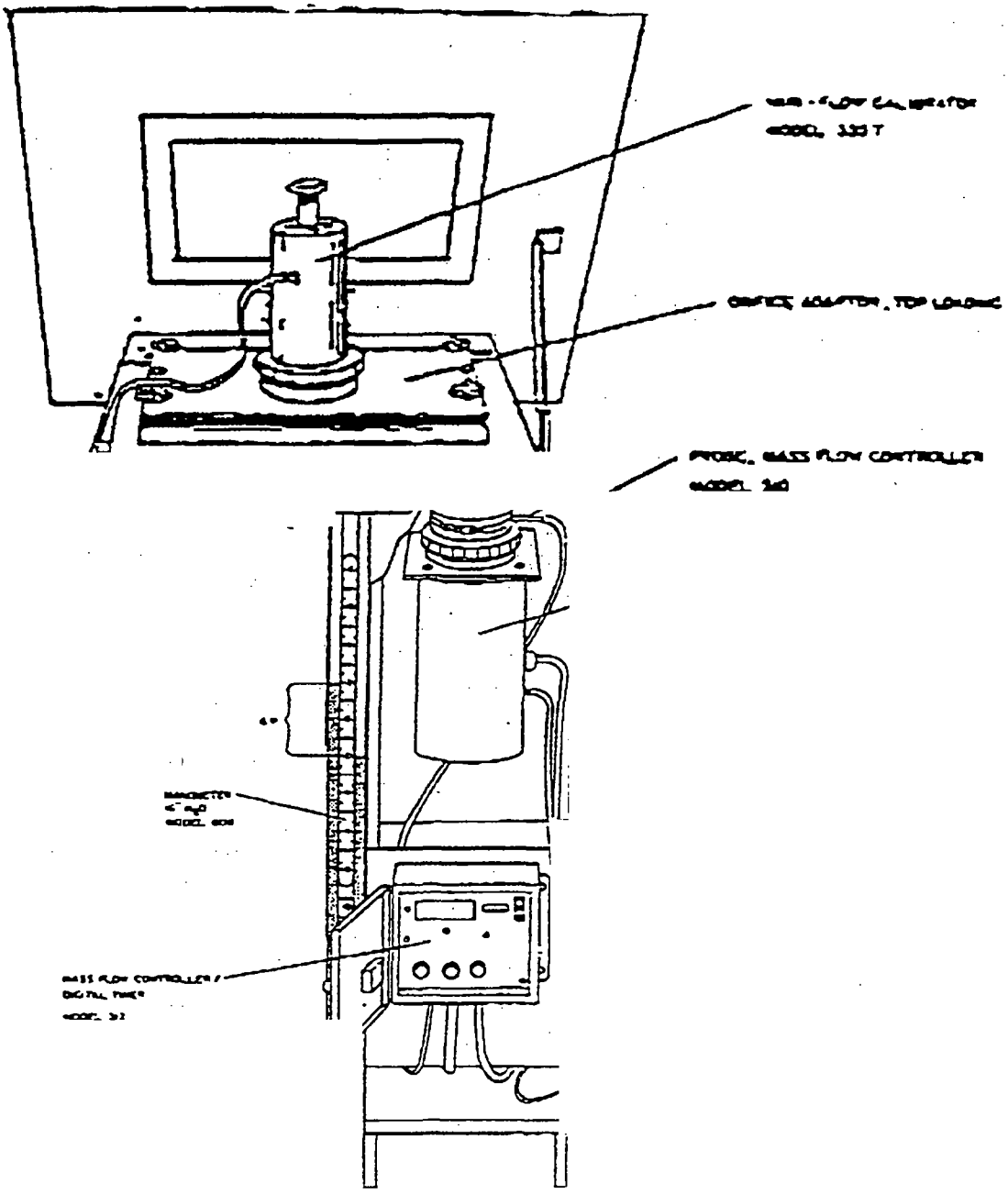
   Note: Manometers used for field calibration may be subject to damage or malfunction and should thus be checked frequently.
4. A thermometer, capable of accurately measuring temperature over the range of 0 to 50°C (273 to 323 K) to the nearest ± 1°C and referenced to an NIST or ASTM thermometer within ± 2°C at least annually. The operator can also use the temperature reading for the specific monitoring station.
5. A portable aneroid barometer (e.g., a climber's or engineer's altimeter) capable of accurately measuring ambient barometric pressure over the range of 500 to 800 mmHg (66 to 106 kPa) to the nearest mmHg and referenced within ± 5 mmHg of a barometer of known accuracy at least annually. The operator can also use the barometric pressure reading from the Duluth Airport Meteorological Station.
6. Miscellaneous hand tools, calibration data sheets or station logbook, and 51-mm (2-inch) duct tape, or rubber stoppers.

Multipoint Flow Rate Calibration Procedure-MFC Sampler

Caution: Do not attempt to calibrate the MFC sampler under windy conditions. Short-term wind velocity fluctuations will produce variable pressure readings by the orifice transfer standard's manometer. The calibration will be less precise because of the pressure variations. In these cases, use a field trailer if available.

1. Set up the calibration system as illustrated by Figure 1. MFC samplers are calibrated without a filter or filter cassette installed.
2. Disconnect the motor from the flow controller/timer and plug it directly into a stable line voltage source. A short 4-foot extension cord may be needed in order to accomplish this.

FIGURE 1
TSP Calibration Setup



3. Install the orifice transfer standard and its adapter faceplate on the sampler. Check all gaskets and replace any questionable ones.

   Caution: Tighten the faceplate nuts evenly on alternate comers to properly align and seat the gaskets. The nuts should be only hand-tightened because too much compression can damage the sealing gasket.

4. Leak Test: Block the orifice with rubber stoppers, wide duct tape, or other suitable means. Make sure the manometer is not connected to the orifice. The vacuum created by the leak check will draw the liquid out of the manometer and into the sampler, resulting in damage to the motor. Seal the pressure port of the orifice by crimping the manometer hose, or a rubber cap can also be used. Turn on the sampler.

   Caution: Avoid running the sampler for longer than 30 seconds at a time with the orifice blocked. This precaution will reduce the chance that the motor will be overheated because of the lack of cooling air. Such overheating can shorten the motor's life. It can raise temperatures to the point of defeating the electrical insulation, which could result in fire or electric shock to the user.

   Gently rock the orifice transfer standard and listen for a whistling sound that would indicate a leak in the system. A leak-free system will not produce an upscale response in the sampler's exit orifice manometer or flow recorder. Leaks usually are caused either by a damaged or missing gasket between the orifice transfer standard and the faceplate, or by cross-threading of the orifice transfer standard on the faceplate. All leaks must be eliminated before proceeding with the calibration. When the system is determined to be leak-free, turn off the sampler and unblock the orifice.

5. Inspect the connecting tubing of both manometers for crimps or cracks. Open the manometer valves (if present) and blow gently through the tubing, watching for the free flow of the fluid.

   Adjust the manometers' sliding scales so that their zero lines are at the bottom of the meniscus. Connect the orifice transfer standard manometer to the orifice transfer standard. Connect the sampler's oil manometer (and the continuous-flow recorder, if used) to the exit orifice plenum port. Ensure that one side of each manometer is open to atmospheric pressure. Make sure that the tubing fits snugly on the pressure ports and on the manometer. The orifice variable adjustment knob should be in the "fully open position."

6. Read and record the following parameters on the TSP MFC Calibration Data Sheet.

   - Date, location, and operator's signature
   - Sampler S/N and model
   - Ambient and seasonal barometric pressure (Pa), mmHg or kPa
   - Ambient and seasonal temperature (Ta), K (K = °C + 273)
   - Orifice S/N and calibration relationship

   Note: Consistency of temperature and barometric pressure units is required. All temperatures will be expressed in Kelvin (K = °C + 273) and all barometric pressures will be expressed in mmHg. Check the seasonal temperature and barometric pressure shown in Table 1 for the correct averages.

Note: Ideally, the temperature of the air in the exit orifice plenum should be measured because it will be somewhat higher than ambient temperature. However, an adequate approximation of this temperature may be obtained by adding 30 K to the, ambient temperature. This addition is incorporated in the calculations given in subsection entitled "Calibration Calculations."

TABLE 2
Seasonal Temperature and Pressure

	Spring April, May, June	Summer July, August, Sept.	Winter Oct, Nov, Dec, Jan, Feb, March
Average Pressure	TBD mmHg	TBD mmHg	TBD mmHg
Average Temperature	49°F	69°F	35°F

7. Turn on the sampler and allow it to warm up to operating temperature (3 to 5 minutes). Then, read and record in the second column the orifice transfer standard's manometer deflection, total)H_2O. Record the sampler's manometer or Dickson chart reading in the fourth column, "Sampler")PEX" on the calibration data sheet. If using the Dickson chart for calibration, tap the box the chart is mounted in to ensure the pen is not stuck.

   Note: The sampler inlet maybe partially lowered over the orifice transfer standard to act as a draft shield (if a shield is not otherwise provided). Use a block to provide at least 2 inches of clearance at the bottom for air flow and for the manometer tubing.

8. Select the first calibration flow rate and adjust the variable orifice valve.

9. Adjust the variable orifice valve to obtain each of the other calibration flow rates. At least five calibration flow rates are required, with at least three in the acceptable flow rate range (i.e., 1.02 to 1.24 m^3/min). If the operator is unsure of what points to run, check the sampler's previous calibration. If this is an initial calibration, the operator should consult the transfer standard's calibration to determine flow rates from the associated manometer readings. The same manometer readings can be generated for the calibration provided they are in the corrected range.

   Repeat Step 9 for any data points that are questionable. Running additional calibration points at differing flow rates or repeating the calibration points at the same flow rates is encouraged to improve the precision of the calibration.

   Note: The data points should be verified in the field or in the shelter as the calibration is occurring.

10. Turn off the sampler and remove the orifice transfer standard.

11. Reconnect the sampler motor to the flow controller.

12. Perform the calibration calculations that are shown. The data generated will be used to set the mass-flow controller to a value that will result in optimal volumetric flow based on the seasonal average temperature and barometric pressure at the monitoring site.

Calibration Calculations

1. Gather together all the calibration data, including the orifice calibration information and the sampler calibration data sheet.

   Note: These calculations should be done at the time of the calibration, rather than later. This approach will allow additional calibration points to be run if questions arise about the data that have already been obtained.

   Verify that the orifice transfer standard calibration relationship is current and traceable to an acceptable primary standard.

2. Calculate and record Qa for each calibration point from the orifice calibration information and write these values under the column labeled "X-Axis" on the MFC sampler calibration data sheet.

$$Qa(orifice) = \{[)H_2O(Ta/Pa)]^{1/2} - b\}\{11m\}$$

Where:

Qa(orifice)	=	Actual volumetric flow rate as indicated by the transfer standard orifice, m^3/min
$)H_2O$	=	Pressure drop across the orifice, inches H_2O (from manometer)
Ta	=	Ambient temperature during use, K (K = °C + 273)
Pa	=	Ambient barometric -pressure during use, mmHg (or kPa)
b	=	Y intercept of the orifice calibration relationship
m	=	Slope of the orifice calibration relationship

3. Calculate and record in the fifth column, Y-Axis, on the data sheet the quantity)Pext for each calibration point as:

$)Pext = [)pext(Ta+30)/Pa)^{1/2}$ (when calibrating with a manometer) or

$It = I[(Ta+30)/Pa]^{1/2}$ (when calibrating with a Dickson chart)

Where:

)Pext	=	Transformed manometer reading
)Pext	=	Sampler manometer reading, inches H_2O
Ta	=	Ambient temperature, K (K = °C + 273)
Pa	=	Ambient barometric pressure, mmHg
It	=	Transformed flow chart reading indicated by Dickson chart
I	=	Indicated flow reading from Dickson chart

4. Using a programmable calculator, determine the linear regression slope (m), intercept (b), and correlation coefficient (r) and record them on the data sheet. A five-point calibration should yield a regression equation with a correlation coefficient of $r > 0.995$, with no point deviating more than ± 0.04 m^3/min from the value predicted by the regression equation. For the regression equation, calculate the data points as follows and record them in the sixth column on the data sheet under "Y-Calc."

)Pext calculated = m[Qa orifice] + b

   Where:

m	=	Slope of the sampler calibration relationship
Qa	=	Transfer standard orifice's actual volumetric flow rate
b	=	Intercept of the sampler calibration relationship

   After these values are obtained, they then need to be compared to the sampler's responses in the fifth column, in order to verify that no point deviates more than ±0.04 m^3/min. To do so, subtract the value in the column labeled "Y-Axis" from the)Pext calculated values above.

   Deviation = (Ycalc)-(Y-Axis)

   Write the results in the "Deviation" column.

   If the resulting deviation value is greater than ± 0.04, rerun that data point again. Generally you will know if any of the data points are unacceptable by the r value generated. R values less than 0.995 indicate that there is a point or points that are outliers.

5. For subsequent sample periods or flow checks, the sampler's average actual operational flow rate, Qa, is calculated from the calibration slope and intercept using the following equation:

   $$Qa = [\text{mean })Pex(Tav+30)/Pav]^{1/2} - b](1/m)$$

   Where:

   Qa = the sampler's average actual flow rate, m^3/min

)pex	=	Average of initial and final sampler manometer readings, ()pex_i +)Pex_f)/2, in H_2O
Tav	=	average ambient temperature for the sample period, K (K = °C + 273)
Pav	=	Average ambient pressure for the sample period, mmHg
b	=	Intercept of the sampler calibration relationship
m	=	Slope of the sampler calibration relationship

Mass-Flow-Controller Adjustment Procedure

Because the controlled flow rate of an MFC sampler is adjustable, it must be set to the proper flow rate for the inlet. The constant mass flow maintained by the MFC causes the actual volumetric flow rate through the inlet to fluctuate as the ambient temperature and barometric pressure change at the monitoring site. Normally, the range of these fluctuations is within the allowable- tolerance limits for the inlet. However, the flow rate set point of the mass-flow-controller- must be correctly adjusted so that the deviations are "centered" with respect to the seasonal average temperature and barometric pressure at the site, not the temperature and pressure prevailing at the time of setting. The correct volumetric set point flow rate (SFR) at Ta and Pa has the same mass flow rate as the inlet design volumetric flow rate at Ts and Ps has.

Note: The correct SFR thus may be different from day to day and may be somewhat higher or lower than the inlet design flow rate on any particular day. Having the set point "centered" will compensate for these fluctuations.

Set the mass-flow-controller as follows:

1. Obtain the seasonal average temperature (Ts) and seasonal average pressure (Ps) at the site and record them on the calibration data sheet. Consult Table 1 for these seasonal pressure and temperature averages.

2. Calculate SFR and record on the calibration data sheet:

   $$SFR = (1.13)(Ps/Pa),(Ta/Ts)$$

   Where:

SFR	=	Set point actual volumetric flow rate for adjustment of the mass-flow controller, based on seasonal average temperature and average pressure at site, m^3/min
1.13	=	Inlet design flow rate (as specified by the manufacturer), m^3/min
Ps, Pa	=	Seasonal average and current ambient barometric pressure at the site, respectively, mmHg
Ts, Ta	=	Seasonal average and current ambient temperature, respectively, K (K = °C + 273)

3. Calculate and record on the sampler's calibration data sheet the sampler set point manometer reading that corresponds to the SFR calculated in Step 2. Label each sampler with the calibration data and the set point. Adhere the label on the motor housing of the sampler near the adjustment for the flow controller. In this manner the sampler set point information is readily available when the operator prepares for a sampling event.

   $$SSP = [Pa/(Ta + 30)][m(SFR) + b]_2 \text{ (for manometers) or}$$
   $$SSP = [Pa/(Ta + 30)]^{1/2}[m(SFR) + b] \text{ (for Dickson charts)}$$

   Where:

SSP	=	sampler set point manometer reading, in H_2O or cfm
Pa	=	ambient barometric pressure, mmHg

Ta	=	ambient temperature, K (K = °C + 273)
m	=	slope of the sampler's calibration relationship
SFR	=	set point flow rate from the equation in Step 2, m^3/min
B	=	intercept of the sampler's calibration relationship

4. Connect the motor to the mass-flow controller. Make sure the manometer is properly connected.
5. Install a clean filter (in a filter cassette) in the sampler according to the manufacturer's instructions.
6. Turn on the sampler and allow it to warm up to operating temperature (3 to 5 minutes).
7. Following the manufacturer's instructions, adjust the mass-flow controller until the manometer reading indicates -the sampler set point (SSP) as calculated in Step 3.
8. Verify that the flow controller will maintain this flow rate for at least 10 minutes. Turn off the sampler.
9. The sampler can now be prepared for the next sample run day.

IV. Field Sampling Procedures

Filter Installation Procedure

Upon arriving at the monitoring site, the site operator will follow these procedures:

1. Before unloading the filters from the samplers, stop at the monitoring shelter below each sampler. Particulate monitoring supplies, i.e., filters, blank field data sheets, Dickson charts, and filter cassettes are stored at each site. It is easier to load and unload the filters inside the shelters. Each sampler has a spare filter cassette for this purpose. The paperwork for the previous sampling episode is kept on shelves mounted on the wall in each shelter. This will be needed to record flow and sample run time information before unloading an exposed filter.
2. Following the manufacturer's instructions, loosen the nuts that secure the inlet to the base and gently tilt back the inlet to allow access to the filter support screen.
3. Examine the filter support screen. If the screen or the metal area round the screen appears dirty, wipe it clean. If the filter cassette is equipped with a protective cover, remove it and place the loaded cassette in position on the sampler support screen. Tighten the thumb nuts sufficiently to hold the filter cassette securely. Check that the gasket is in good condition and has not deteriorated.

   Caution: Tighten the thumb nuts evenly on alternate comers to properly align and seat the gasket. The nuts should be hand-tightened because too much compression can damage the sealing gasket.
4. Lower the sampler cover.
5. Open the front door of the sampler and examine the flow recorder. Remove any moisture inside by wiping it with a clean cloth. Record the sampler S/N, filter ID

number, site location, and sampling date on the back of a clean chart and install the chart in the flow recorder.

While installing the chart, do not bend the pen arm beyond its limits of travel. Raise the pen head by pushing on the very top of the pen arm (or by using the pen lift). Be sure that the chart tap is centered on the slotted drive to ensure full 360-degree rotation in 24 hours. Make sure that the chart edges are properly located beneath the retainers. Lower the pen arm and tap the recorder face lightly to make certain that the pen is free.

(Note: During periods of inclement weather, the chart tends to stick to the recorder face. Two charts can be installed simultaneously to enable the sample [top, annotated] chart to rotate freely.)

6. Using a coin or slotted screwdriver, advance the chart and check to see that the pen rests on zero—the smallest circle diameter. If necessary, adjust the zero set screw while gently tapping on the side of the flow recorder. If a chart with a linear-function scale is used, some positive zero offset may be desirable to allow for normal variations in the zero readings.

7. Turn on the sampler and allow it to equilibrate to operating temperature (3 to 5 minutes).

8. While the sampler is equilibrating, record the following parameters on the MFC sampler field data sheet.

   - Site location
   - Sample date
   - Filter ID number
   - Sampler model and S/N
   - Operator's initials

9. Inspect the manometer for crimps or cracks in its connecting tubing. Replace the tubing if needed. Open the valves and blow gently through the tubing of the manometer while watching for the free flow of the fluid. Adjust the manometer's sliding scale so that its zero line is at the-bottom of the meniscuses.

10. Measure the initial exit orifice plenum pressure ()Pex) using an oil or water manometer, 0- to 8-inch range and a minimum scale division of 0. 1 inch. Record the initial)Pex on the MFC sampler field data sheet. If)Pex is substantially different than for previous samples or otherwise appears abnormal, carry out a QC flow check as described in the section entitled, "Point Flow Check."

11. Verify that the flow recorder is operational and that the pen is inking.

12. Turn the sampler off.

13. Check the time indicated by the time-set pointer on the flow recorder. If it is in error, rotate the chart clockwise by inserting a screwdriver or coin in the slotted drive in the center of the chart face until the correct time is indicated.

14. Check the following on the digital timer/programmer:

- Note the number on the elapsed time meter and write this on the field data sheet under "start."
- Check the display readout, making sure the current time is correct and the sample start time reads 0000 minutes.
- The sampler power toggle switch should be in the middle "timed" position.
- Set the "sample after" switch to the number of days to be skipped before the sampling period. For instance, if the sample network is to operate every other day, the "sample after" switch should indicate "0" if the scheduled sampling day starts at midnight of the day the set up is taking place. Position "0" will initiate the first sampling period the first time the "time of day' = "sample start time."
- "Sample every X days" should be set for "6."
- "Sample for X hours" should be set for "24."
- Push "set" switch down to "timer" position momentarily. This step must be done after getting the previous timer/programmer positions as outlined above.
- The sampler power toggle switch should be in the middle "timed" position.

15. Close the sampler door, taking care not to crimp the vacuum tubing or power cords.
16. Make sure the sampler is within the guidelines for sampling that are described on the field data sheet. If the sampler fails to meet these guidelines, correct as necessary and document all activities in the site logbook and on the field data sheet. The sampler is now ready to sample ambient air.

Filter Recovery Procedure

When sampling is finished, the operator should return to the monitoring site to retrieve the exposed filter. Particle loss or filter damage will result if the filter is left in the sampler for extended periods.

1. Turn on the sampler and allow it to equilibrate to operating temperature (3 to 5 minutes).
2. Measure the final)Pex and record it on the MFC sampler field data sheet.
3. Turn off the sampler.
4. Open the door of the sampler, remove the flow recorder chart, and examine the recorder trace. If the trace indicates extensive flow fluctuations, investigate and correct before the next sampling day.
5. Record the elapsed time of the sampling period on the MFC sampler field data sheet.

   Note: Tav and Pav readings will be obtained by the data coordinator using the meteorological data available from the respective sites.
6. Observe conditions around the monitoring site; note any activities that may affect filter particle loading (e.g., paving, mowing, fire) and record this information on the MFC sampler field data sheet.

7. Raise the sampler inlet and remove the filter cassette. To avoid particle loss, be careful to keep the cassette as level as possible. Cover the cassette with the metal protective cover provided.

8. The sampler may now be readied for the next run day. Reload the sampler with a filter and cassette unit and Dickson chart. Reset the sampler timer and check the initial flow.

9. Keeping the filter cassette level, carefully transport it, the data sheet, and the flow recorder chart to the site shelter for sample recovery.

   Post-sampling filter cassette handling procedures include the following:

   - Remove the top frame of the filter cassette, taking care not to disturb the sample. Vinyl surgical gloves will be worn during filter recovery.
   - Check the sample's validity using as guidelines the validation criteria for the field operator found in the next section.
   - Carefully slip a manila folder underneath the edge of the exposed filter. The filter may stick in the cassette because of overcompression of the filter cassette gasket. Be extremely careful to avoid damage to the brittle quartz filter.
   - Fold the filter once lengthwise, with the exposed portions of the filter touching only exposed portions of the filter. Place the folded filter in the 4.5 by 10.5 glycine envelope provided in each filter packet. If pieces of filter get broken off while placing the filter in the envelope, gather the pieces and place them into the envelope also. Note this on the field data sheet.
   - Place the filter, the Dickson chart, and the top NCR copy of the field data sheet into the envelope in which the filter was originally shipped. This envelope should be stamped with the filter's number.

10. At the end of each sampling event, ship filters, field data sheets, and Dickson charts to the laboratory, using a chain-of-custody form. Minimum information required is the sampling data, the filter number and the site name. The operator needs to sign and date under "sampler" and "relinquished by." Place the filters, Dickson charts, and field data sheets in an envelope with the top two NCR copies of the chain-of-custody form. Place two pieces of stiff cardboard in the envelope, one on either side of the stack of filters, as protection while shipping. Seal envelope and place signed custody seals on each end of glued portion of envelope. Filters should be shipped via Federal Express or other registered means to the laboratory.

11. The field operator will keep on file copies of field data sheets, chain-of-custodies, calibration data sheets, and courier shipments.

V. Sample Validation and Documentation

Validation Criteria

Field. The following criteria have been established to assist the operator in initially determining whether a sample is valid. If a sample fails to meet these criteria, do not discard the filter. Document any factors observed that may result in a sample's invalidation on the

sample data sheet, and forward the data sheet, the Dickson chart, and the filter to the laboratory. The data coordinator and the laboratory supervisor will make the final decision regarding the sample's validity.

1. Timing:

   - All samplers must be turned ON and OFF within 1/2 hour of 7:00 a.m.
   - All samplers must operate for at least 23 but no more than 25 hours (1,380 to 1,500 minutes).

2. Sample condition:

   - Sample prior to recovery shows no signs of tears or leaks: leaks can be detected by inspecting the exposed edge of the filters for "fuzziness." There should be clear demarcation between the exposed and unexposed portions of the filter.

3. Flow rates:

   After each sampling period, calculate the percentage difference between Qa and the design flow rate (1. 13 m^3/min) using the following formula:

$$\text{Error! Bookmark not defined.}\ \%\,\text{Difference} = 100\left[\frac{Qa - 1.13}{11.3}\right]$$

$\overline{Qa}$ must be within flow rate limits specified by the inlet manufacturer. The design flow rate of the TSP models at Arrowhead have an acceptable flow rate range of 90 to 110 percent of 1. 13 m^3/min (i. e., 1.02 to 1. 24 M^3/min) expressed in actual volumetric flow rate. If these limits are exceeded, investigate potential error sources immediately. The following criteria should be used as the basis for determining a sample's validity:

- Decreases in flow, rate during sampling (because of mechanical problems) of more than 10 percent from the initial set point result in sample invalidation. Recalibrate: the sampler. A sample. flow rate may also fluctuate because of heavy filter loading. If a high TSP concentration is suspected, the operator should indicate this on the field data sheet. The laboratory supervisor will make the final decision regarding the sample's validity.
- Changes in flow rate calibration of more than 10 percent, as determined by a field QC flow rate check, will invalidate all samples collected back to the last calibration or valid flow check. Recalibrate the sampler.

Field QC Procedures

This section will describe field quality assurance procedures performed in the field. These include scheduled flow checks of the sampler as well as collection of trip and field blanks and sample duplicates. These procedures help determine the precision and accuracy of the samplers.

One-Point Flow Check

For mass-flow-controlled TSP samplers, a field-calibration check of the operational flow rate is performed after every 4 sampling days. The purpose of this check is to track the sampler's

calibration stability. A control chart presenting the percentage difference between a TSP -sampler's indicated and measured flow rates will be maintained. This chart provides a quick reference of instrument flow rate drift problems and is useful for tracking the performance of the sampler. A flow check data sheet will be used to document flow check information. This information includes instrument and transfer standard model and serial numbers, ambient temperature-and pressure conditions, and collected flow check data.

In this subsection, the following is assumed:

- The flow rate through a TSP sampler that is equipped with a mass-flow controller is indicated by the exit orifice plenum pressure. This pressure is measured from the sampler's manometer.
- The Andersen mass-flow-controlled TSP model is designed to operate at an actual flow rate of 1. 13 m^3/min, with an acceptable flow rate fluctuation range of 10 percent of this value.
- The transfer standard will be an orifice device equipped with a water or oil manometer.
- The orifice transfer standard's calibration was performed in accordance with prescribed EPA and ADEC guidelines and that the transfer standard's calibration relationship is in terms of the actual volumetric flow rate (Qa).

QC Flow Check Procedure

The indicated flow rate (Qa (sampler)) for MFC samplers is calculated by determining: (1) the manometer reading of the exit orifice plenum pressure (or the flow recorder reading), (2) the ambient temperature (Ta), and (3) the barometric pressure (Pa) during the flow check. These values are then applied to the sampler's calibration relationship.

Note: Do not attempt to conduct a flow check of TSP samplers under windy conditions. Short-term wind velocity fluctuations will produce variable pressure readings by the orifice transfer standard's manometer. The flow check will be less precise because of the pressure variations. If windy conditions exist, the utility tent should be set up over the sampler.

1. Sampler flow checks involve the following equipment:
   - A water or oil manometer with a 0- to 8-inch range and a minimum scale division of 0. 1 inch for measurement of the sampler's exit orifice plenum pressure. This manometer is mounted inside the sampler housing.
   - An orifice transfer standard and its calibration relationship.
   - An associated water or oil manometer with a 0- to 16-inch range and a minimum scale division of 0. 1 inch for measurement of the orifice transfer standard's flow rate.
   - A thermometer capable of accurately measuring temperature over the range of 0 to 50°C (273 to 323 K) to the nearest ± 1°C and referenced to an NIST or ASTM thermometer within ± 2°C at least annually. The operator can also use the ambient temperature reading for the ambient air monitoring shelter associated with each sampler.

- A portable Aneroid barometer :(e.g., a climber's or engineer's altimeter) capable of accurately measuring ambient pressure over the range of 500 to 800 mmHg (66 to 106 kPa) to the nearest millimeter Hg and referenced within ± 5 mmHg of a barometer of known accuracy at least annually. The barometric pressure can also be obtained from the onsite meteorological station.
- The sampler's calibration information.
- A clean filter.
- MFC sampler flow check data sheet.

2. Set up the flow check system as if performing a calibration with a filter. MFC samplers are normally flow checked with a filter in line (i.e., between the orifice transfer standard and the motor). Install a clean filter in the sampler. Place the filter directly upon the sampler's filter screen. Do not use a filter cassette. A flow check filter should never be used for subsequent sampling. The sample mass will be biased as a result of using a filter for both a flow check and-subsequent sampling.
3. Install the orifice transfer standard and its faceplate on the sampler. Do not restrict the flow rate through the orifice by closing the variable-resistance valve.

   Caution: Tighten the faceplate nuts on alternate comers first to eliminate leaks and to ensure even tightening. The nuts should be hand-tightened; too much compression can damage the sealing gasket. Make sure the orifice transfer standard gasket is in place and the orifice transfer standard is not cross-threaded on the faceplate.
4. Connect the orifice manometer to the pressure port of the orifice transfer standard and the sampler manometer to the sampler's exit orifice plenum is on line. Inspect the manometers' connecting tubing for crimps and cracks. Open the manometer valves and blow gently through the tubing. Watch for the free flow of fluid. Adjust the manometers' scale so that their zero lines are at the bottom of the meniscuses. Make sure that the connecting tubing snugly fits the manometer and the pressure port.
5. Turn on the sampler and allow it to warm up to operating temperature (3 to 5 minutes).
6. Read and record the following parameters on the MFC sampler flow check data sheet:
   - Sampler location and date
   - Sampler model and S/N
   - Ambient temperature (Ta),°C and K
   - Ambient barometric pressure (Pa), mmHg
   - Unusual weather conditions
   - Orifice transfer standard S/N and calibration relationship
   - Operator's signature
   - Sampler's calibration relationship
7. Observe the)H_2O across the orifice by reading the manometer deflection and record this number on the flow check data sheet, under "orifice pressure drop."

8. Measure the sampler's pressure drop ()Pex) by reading the manometer deflection. Record the manometer deflection on the flow check data sheet.

9. Turn off the sampler and remove the orifice transfer standard, but not the filter. Install the cassette filter holder and filter. Turn on the sampler and repeat Step 8 to check the flow rate under normal operating conditions. This procedure is performed in order to calculate the sampler's design flow rate. Turn off the sampler and remove the filter.

10. Calculate and record Qa(orifice) at actual conditions using the following equation:

$$Qa(orifice) \quad \{[)H_2O)(Ta/Pa)]^{1/2}-b\}\ \{1/m\}$$

Where:

Qa(orifice) = Actual volumetric flow rate as indicated by the orifice transfer stand and (m^3/min)

$)H_2O$ = Pressure drop across the orifice, inches H_2O

Ta = Ambient temperature, K

Pa = Ambient - barometric pressure, mmHg

b = Intercept of the orifice. calibration relationship

m = Slope of the orifice calibration relationship

11. Calculate and record the corresponding sampler flow rate at actual conditions and record.

$$Qa(sampler) \quad \{[)Pex\ (Ta + 30)/Pa]1/2-b\}\ \{l/m\}$$

Where:

Qa(sampler) = Sampler flow rate, actual m^3/min

Pex = Sampler's pressure, as measured by the sampler's manometer, inches H_2O

Ta = Ambient temperature during the flow check, K (K = °C + 273)

Pa = Ambient barometric pressure during the flow check, mmHg or kPa.

b = Intercept of the MFC sampler calibration relationship

m = slope of the MFC sampler calibration relationship

12. Using this information and the formulas provided on the MFC sampler flow check data sheet, calculate the QC check percentage differences.

$$\text{QC - check \% difference}\left[\frac{Qa(sampler) - Qa(orifice)}{Qa(orifice)}\right][100]$$

Where:

Qa(sampler) is measured with the orifice transfer standard installed.

Record this value on the MFC sampler flow check data sheet. If the sampler flow rate is within 93 to 107 percent (± 7 percent difference) of the calculated Qa(orifice) flow rate (in actual volumetric units), the sampler calibration is acceptable. If these limits are exceeded, investigate and correct any malfunction. Recalibrate the sampler before sampling is resumed. Differences exceeding ± 10 percent may result in the invalidation of all data collected subsequent to the last calibration or valid flow check. Before invalidating any data, the data coordinator will double-check the orifice transfer standard's calibration and all calculations.

13. Calculate the corrected sampler flow rate, Qa(corr. sampler) using the following calculation:

$$Qa(\text{corr.sampler}) = [Qa(\text{sampler}]\left[\frac{[100 - \%\,\text{difference})}{100}\right]$$

Where:

Qa(sampler) is measured without the orifice transfer standard being installed and where the QC-check percentage difference was obtained from equation above.

14. Calculate and record on the MFC sampler flow check data sheet the percentage difference between the inlet's design flow rate (e.g., 1. 13 m^3/min) and the corrected sampler flow rate as:

$$\text{Design flow rate \% difference} = \left[\frac{Qa(\text{sampler}) - 1.13)}{1.13}\right] - [100]$$

It is assumed that the inlet is designed to operate at a flow rate of 1. 13 actual m^3/min. If the design flow rate percentage difference is less than or equal to 7 percent, the sampler calibration is acceptable. If the difference is greater than ±7 percent, investigate potential error sources and correct any malfunction. Recalibrate the sampler before sampling is resumed. Differences exceeding 10 percent may result in the invalidation of all data collected subsequent to the last calibration or valid flow check. Before invalidating any data, double-check the sampler's calibration, the orifice transfer standard's certification, and all calculations.

Note: Deviations from the design flow rate may be caused in part by deviations in the site temperature and pressure from the seasonal average conditions. Before invalidating any data or recalibrating, recalculate the optimum set point flow rate (SFR) to determine if the flow controller should be adjusted.

15. Set up the sampler for the next sampling period according to the-usual operating procedures.

VI. Calculations, Validations, and Reporting of TSP Data

Measurements of TSP mass concentration in the atmosphere that are used to determine attainment of the National Ambient Air Quality Standards for particulate matter, must be

expressed in units of micrograms per standard cubic meter (μg/std m^3) of air. For these measurements, "standard" means EPA standard conditions of temperature and pressure, which are 25°C (298 K) and 760 mmHg, respectively. This section presents the calculations required to compute and report ambient TSP concentrations.

Particle size discrimination by inertial separation requires that specific air velocities be maintained in the sampler's air inlet system. These design velocities are obtained when a specified "design flow rate" is maintained. The design flow rate is specified as an actual volumetric flow rate (Qa), measured at existing conditions of temperature (Ta) and pressure (Pa).

The sampler's operational flow rate (i.e., the actual flow rate when the sampler is operating normally to collect a TSP sample) will be maintained very close to the design flow rate. The TSP sampler's flow rate measurement system must be calibrated periodically with a certified flow rate transfer standard. Ambient temperature and barometric pressure are required to get an accurate indication of the operational flow rate. For determining the average sampler flow rate over a sample period, the average temperature (Tav) and average barometric pressure (Pav) over the 24-hour sample period will be used.

Calculations

Flow Rate Calculations

The following procedures are used for calculating the average ambient flow rate of the HV TSP sampler. In this subsection, it is assumed that the samplers have been calibrated according to procedures outlined in this section.

Note: Consistency in units is required. The designations of K for temperature and mmHg for pressure is recommended in all calculations.

The average actual flow rate for the sample period is calculated by determining (1) the average of the initial and final manometer readings ()Pex), (2) the average ambient temperature (Tav), and (3) the average ambient barometric pressure (Pav) during the sampling period and applying these values to the calibration relationship.

Each sampler's flow measurement system will be calibrated periodically, and the calibration will be described by a mathematical expression (e.g., a least squares linear regression equation) that indicates the slope and intercept of the calibration relationship. Following the procedure in this section this expression is in the form of:

$$Qa = \{\text{mean })Pex(Tav+30)/Pav)]^{1/2} - b\}\{1/m\}$$

Where:

Qa = the sampler's average actual flow rate for the sample period, m^3/min

)Pex = average of initial and final, sampler manometer readings, ()Pex_i +)Pex_f)/2, inches H_2O

Tav = average ambient temperature for the sample period, K (K =°C + 273)

Pav = average barometric pressure for the sample period, mmHg (or kPa)

b = intercept of the sampler calibration relationship

m = slope of the sampler calibration relationship

The average actual flow rate is then corrected to EPA-standard conditions, calculated as:

$$\overline{Qstd} = Qa(Pav/Pstd)(Tstd/Tav)$$

Where:

$\overline{Qstd}$ = average sampler flow rate corrected to EPA-standard volume flow rate units, std m^3/min

3/Min

$\overline{Qa}$ = Average actual sampler flow rate for the sample period, m

Pstd = Standard barometric pressure, 760 mmHg

Tstd = Standard temperature, 298 K

Calculation of TSP Concentrations

Accurate reporting of TSP mass concentration data requires the calculation of the total standard volume of air sampled and the final computation of total TSP mass concentration.

1. Calculate the total standard volume of air sampled:

$$Vstd = (\overline{Qstd})(t)$$

Where:

Vstd = total volume of air sampled in standard volume units, std m^3

$\overline{Qstd}$ = average sampler flow rate corrected to EPA standard conditions, std m^3/min

t = Total elapsed sampling time, minutes

2. Calculate total TSP mass concentration in µg/std m^3:

$$TSP = (Wg - Wt)/Vstd$$

Where

TSP = total suspended particulate mass concentration, µg/std m^3

10_6 = conversion factor, µg/g

Wg, Wt = gross and tare weights of the high-volume TSP filter, respectively

Vstd = total sample volume in standard volume units, std m^3

Table 2 is a summary of formulas associated with TSP monitoring. Table 3 contains acronyms associated with TSP monitoring.

TABLE 2
Formulas Associated with TSP Monitoring

Calculation	Formula
Conversion of flow rate from actual to standard volume units	Qstd = Qa(Pa/Pstd)(Tstd/Ta)
Conversion of average flow rate from actual to standard volume units	QSTD = Qa(Pav/Pstd)(Tstd/Tav)
Conversion of flow rate from standard to actual volume units	Qa = Qstd(Pstd/Pa)(Ta/Tstd)
Uncorrected air volume measured by standard volume meter	)Vol. = Final Volume - Initial Volume
Correction of air volume measured by std. vol. meter to ambient baro. Pressure	Va)Vol.(Pa -)Hg)/Pa
Actual volumetric flow rate measured by standard volume meter	Qa = Va/)Time
Actual volumetric flow rate measured by orifice transfer standard	Qa(orifice) = {[)H_2O(Ta/Pa)$^{1/2}$ - b) (1/m)
Transformed exit orifice pressure for MFC sampler calibration relationship	)Pext [)Pex(Ta+30)/Pa]$^{1/2}$
Transformed flow recorder reading for MFC sampler	It I[Ta+30)/Pa]$^{1/2}$
Calibration relationship Regression model (y=mx+b) for calibration of MFC sampler	)Pext m[Qa(orifice)] + b
Regression model (y=mx+b) for calibration of MFC sampler using flow recorder	It = m[Qa(orifice)] + b
Calibration relationship for MFC sampler when using a manometer or a device without a square-root function built into scale	QA {[)Pex(Tav+30)/Pav)]1/2 – b} {1/m)
Calibration relationship for MFC sampler using flow recorder such as a Dickson chart	Qa = {[(Tav+30)/Pav]$^{1/2}$ - b) {1/m}
Set-point flow rate for MFC Sampler	SFR = (1.13)(Ps/Pa)(Ta/Ts)
Set-point manometer reading for MFC sampler	SSP [Pa/(Ta+30)][m(SFR) + b]^2
Set-point reading for MFC sampler using flow recorder	SSP [m(SFR) + b][Pa/(Ta+30)]$^{1/2}$
Conversion of manometer reading in inches of H_2O to MM Hg	mm Hg = 25.4(in. H_2O/13.6)
Audit or QC flow check of sampler calibration	$\%\,\text{diff} = .\left[\frac{[\text{Qa(sampler)} - \text{Qa(audit)}}{\text{Qa(audit)}}\right][100]$
Audit or QC flow check of sampler operational flow rate	$\%\,\text{diff.} = \left[\frac{\text{Qa(audit)} - 1.13}{1.13}\right][100]$

TABLE 2
Formulas Associated with TSP Monitoring

Calculation	Formula
Total air volume sampled	Vstd = (Qstd)(t)
TSP mass concentration	TSP = (10^6) (Wg - Wt)/Vstd
Corrected sampler flow rate under normal operating conditions during audits and QC flow checks	$QA(\text{corr. Sampler}) = Qa(\text{sampler})\left[\frac{100 - \%\,\text{difference}}{100}\right]$

Symbols

B Intercept of linear regression calibration relationship

)H_2O Pressure drop across a transfer standard orifice, in. (or cm) of water Column

TABLE 3
Acronyms Associated with TSP Monitoring

)Hg	Differential pressure at inlet to standard volume meter, nun Hg
I	Flow recorder chart reading, arbitrary units on square-root-function Scale
$\overline{I}$	Average flow recorder chart reading over the sample period, arbitrary units on square-root-function scale
It	Transformed flow recorder reading, for calibration relationship
In	Slope of linear regression calibration relationship
Pa	Current ambient barometric pressure, mm Hg
Pav	Average ambient barometric pressure for the sample period, min Hg
)Pex	Pressure in exit orifice plenum of sampler, measured with respect to atmospheric pressure, in. (or cm) water column
$\overline{)Pex}$	Average of initial and final)Pex readings, in. (or cm) H_2O
$\overline{)Pext}$	Transformed exit orifice,- plenum pressure, for- calibration relationship, in. (or cm) water column
TSP	Total suspended particulate mass concentration, j4g/std. m^3
Pstd	EPA-standard atmospheric pressure, 760 mm Hg (or 101 kPa)
Qa	Sampler flow rate measured in actual volumetric units, m^3/min
$\overline{Qa}$	Average sampler flow rate for the sample period measured in actual volumetric units, m^3/min
Qa(audit)	Sampler flow rate in actual volumetric units determined by a flow rate audit, m^3/Min
Qa(orifice)	Flow rate measured by an orifice transfer standard in actual Volumetric units, m^3/min
Qa(sampler)	Flow rate in actual volumetric units indicated by sampler's calibration

TABLE 3
Acronyms Associated with TSP Monitoring

)Hg	Differential pressure at inlet to standard volume meter, nun Hg
	Relationship during flow rate audit or QC flow check, m^3/Min
Qstd	Flow rate measured in EPA-standard volumetric units, std. m^3/Min
Qstd	Average sampler flow rate for the sampler period in standard volumetric units, std m^3/Min
SFR	Set-point flow rate in actual volumetric units for MFC sampler, m^3/min

Calculation Validation

Data that are needed to compute the mass concentration of TSP originate from two main sources: field operations and laboratory operations. These data must be validated to ensure that all reported TSP measurements are accurate relative to the overall scope of the quality assurance program. When the final mass concentration of TSP in a sample has been computed, the validation procedure not only will check on these computations, but also will aid in the flagging of questionable mass concentrations (i.e., extremely high or low values). Therefore, should a mass concentration approach the primary or secondary ambient air quality standard, this validation procedure will provide checks for all preliminary field and laboratory operations. The steps of the calculation validation procedure are as follows:

1. Gather the following data for each sample:
   - Total sampling time (minutes)
   - Average actual volumetric flow rate, Qa (m^3/min)
   - Tare and gross weights, Wt and Wg, of the high-volume TSP filter (g)
2. Recalculate the total mass concentration of TSP for seven samples per 100 (minimum of four per lot). These suggested frequencies may be adjusted subsequently, based on accumulated experience and level of data quality. Decrease the frequency if experience indicates that data are of good quality, or increase it if data are of marginal or poor quality. It is more important to be sure that the validation check is representative of the various conditions that may influence data quality than to adhere to a fixed frequency
3. Compare each validated TSP concentration with the originally reported value. Correct any errors that are found, initial them, and indicate the date of correction. If a high percentage of errors is found, check additional calculated values. If consistent errors are found, check all values in the block of data and investigate and correct the cause.
4. Scan all total mass concentration values; note those that appear excessively high or low and investigate. Repeat Steps 2 and 3 for these samples.
5. If all mass concentration computations appear correct and questionably high or low values still exist, review all raw data (i.e., sample time, average
6. Actual volumetric flow rate, and its subsequent correction to standard conditions) for completeness and correctness.

Maintenance

The overall objective of a routine preventive maintenance program is to increase the reliability of the measurement system and to provide for more complete data acquisition.

This section outlines general maintenance procedures for TSP samplers. For more complete information on a particular sampler, the field operator should refer to the manufacturer's instruction manual for the individual instrument. Table 4 summarizes maintenance activities for the high-volume TSP sampler.

TABLE 4
Routine Maintenance Activities

Equipment	Frequency and/or Method	Acceptance Limits	Action if Requirements Are Not Met
Sampler base			
Powerlines	Check for crimps or cracks. Check for vacuum.	No obvious damage.	Replace as necessary.
Manometer	Check for sufficient liquid level and leaks.	Legible; pressure registers.	Replace as necessary.
Filter screen and throat	Visually check on sample-recovery days.	No obvious deposits; clean with wire brush.	Clean.
Gaskets	At 3-month intervals, inspect all gaskets in the sampler.	No leaks; no compression damage evident.	Replace as necessary.
Brushes	Replace after 400 hours of operation.	Stable flow rate.	Replace as necessary.
Motor	Replace if needed.	Correct model must be used.	Obtain correct model.
Flow controller	Check when flow rate changes are evident.	Stable flow rate throughout sample run.	Replace or repair if possible.
Recording device	Inspect when experiencing difficulty in zeroing, or when large changes in flow rates occur.	Recorder stays zeroed; chart advances; pen inks.	Replace or repair if possible.
Tubing, fittings	Visually inspect on sample-recovery days.	No crimps, cracks, or obstructions; no cross-threading.	Replace as necessary.

Records will be maintained for the maintenance schedule of each TSP sampler. Files will reflect the history of maintenance, including all replacement parts, and an inventory of on-hand spare equipment for each sampler.

Maintenance Procedures

The TSP sampler comprises the flow control system or the sampler base. The following procedures will be performed on the sampler base:

The sampler base is equipped with the following items that require maintenance:

1. Connecting tubing and power lines, which must be checked for crimps, cracks, or obstructions on sample recovery days. Fittings should be inspected periodically for cross-threading and tightness.

2. A filter screen, which should be inspected on sample recovery days for any impacted deposits.

3. Filter cassette gaskets need to be inspected each time a cassette is loaded. A worn cassette gasket is characterized on exposed filters by a gradual blending of the boundary between the collected particulates and the filter border.

4. Motor and housing gaskets, which should be checked at 3-onth intervals and replaced as necessary.

5. Blower motor brushes, which should be replaced before they become worn to the point that damage may occur. Motor brushes will be replaced after 400 hours of operation. A pumice stone can be used against the motor's contacts to ensure high conductivity. The field operator will change the brushes according to manufacturer's instructions, and will recalibrate the sampler according to the procedures described earlier in this section. Use only replacement motor brushes that indicate they are for TSP motors. Before recalibration the motor brushes need to be "seated."

   To achieve the best performance, new brushes should be properly seated on the motor's commutator before full voltage is applied to them. After the brushes have been changed, operate the sampler at 50 to 75 percent of normal line voltage for approximately 30 minutes. The motor should return to full performance after an additional 30 to 45 minutes at normal line voltage.

6. If a motor needs to be replaced, the operator will ensure that the lower-current motors used in TSP sampling are used.

7. A flow controller, which should be replaced if the flow recorder or manometer indicate no flow, low flow, excessive flow, or erratic flow. The flow controller will be sent back to manufacturer for repairs or replacement.

8. A flow recorder requires very little maintenance, but does deteriorate with age. Difficulty in zeroing the recorder and/or erratic traces suggest a problem and need to be investigated. The recorder pens should be replaced every 30 recording days or as needed. In the summer the pens may need to be changed more often.

9. The sampler's manometer may become difficult to read because of aging. If the fluid level becomes difficult to read because the u-tube has become cloudy, replace the manometer. Make periodic checks to make sure connecting tubing to the motor is not cracked or crimped. If the tubing shows signs of age (i.e., cracks or brittleness), replace as necessary. Often a vacuum is created in the manometer, resulting in no pressure drop.

This can be corrected by gently blowing into the connecting tubing, making sure the deflection in pressure registers on the sampler's manometer.

Refurbishment of High-Volume TSP Samplers

If operated in the field for extended periods, high-volume TSP samplers may require major repairs or complete refurbishment. If so, the manufacturer's instrument manual will be consulted before work is undertaken. A sampler that has undergone major repairs or refurbishment must be leak-checked and recalibrated prior to sample collection.

VII. Assessment of Monitoring Data for Precision and Accuracy

Precision

Collocated TSP samplers at Arrowhead will be the same model and have similar flow rates. The two collocated samplers will be located approximately 4 meters apart to preclude air flow interference. Calibration, sampling, and analysis are the same for both collocated samplers and all other samplers in the network. The particulate and the lead concentrations from both samplers are reported. The percentage differences in measured concentrations (micrograms/standard cubic meter) between the two collocated samplers are used to calculate precision.

Accuracy

The accuracy of the high-volume TSP sampler method in the measurement of TSP is assessed by checking the sampler's operational flow and by auditing the sampler's performance. Both of these procedures use flow rate transfer standards, however the performance audit is conducted with a transfer standard different from the standard used to calibrate and check flows. Details of the flow check procedure are found earlier in this section. Flow rate performance audits are performed every quarter using procedures prescribed in "Quality Assurance Handbook for Air Pollution Measurement Systems" (EPA-600/477-027a April 1989). If the percent difference between the sampler and the transfer standard exceeds 7 percent, the sampler is recalibrated. If the percent difference exceeds 10 percent, the data is invalidated.

VIII. Recommended Standards for Establishing Traceability

The attainment of accurate data requires the performance of QA checks, independent audits of the flow measurement process, careful documentation of monitoring data, and the use of equipment and standards that can be traced to appropriate primary standards.

1. Class-S weights of NIST specifications are recommended for the laboratory balance calibration.

2. Use of positive-displacement standard volume meter (e.g., a Roots MeterTM) is used for calibrating the flow rate transfer standards that are used to calibrate and audit the TSP -sampler. The transfer standards for calibration and auditing are recalibrated once a year, using procedures prescribed in "Quality Assurance Handbook for Air Pollution

Measurement Systems" (EPA-600/4-77-027a, April 1989). Copies of flow rate transfer standard calibrations are kept on file with the TSP data coordinator.

3. The elapsed-time meter will be checked upon initial receipt and referenced at least annually against an accurate timepiece to within 15 min/day.

4. The accuracy of associated monitoring equipment (i.e., thermometers, barometers, etc.) will be checked at routine intervals at least once per year, against standards of known accuracy and traceable to NIST.

FIELD OPERATING PROCEDURE NO. 8

Turbidity Measurement by Portable Meter

I. Purpose

The purpose of this Field Operating Procedure (FOP) is to describe the protocol for field operation of a turbidity meter.

II. Scope

Use of this FOP will provide water quality data during collection of aqueous samples including surface water, groundwater, monitoring sampling and well development.

III. Equipment and Materials

- Turbidity meter (Hach Model 2100P or equivalent)
- Turbidity standards

IV. Procedures and Guidelines

Calibration

Turn unit on and place the first standard in the holder, making sure to clean the glass of all dirt and fingerprints using a clean, soft cloth. Always align the sample vial with the "front" mark towards the front. Press CALIBRATE. Select the turbidity of the standard with the arrow keys, press READ and wait for unit to complete the cycle. Repeat for the rest of the standards. Record calibration standards and readings in the logbook.

Measure Turbidity

Rinse the sample vial several times with the water to be read, then fill the bottle to the top. Turn unit on and place the sample in the holder, making sure to clean the glass of all dirt and fingerprints using a clean, soft cloth. Always align the sample vial with the "front" mark towards the front of the unit. Press READ and wait for cycle to complete. Record the reading in the logbook.

V. Attachments

None.

VI. Key Checks and Items

1. Clean sample vial with a soft, clean cloth
2. Place sample vial inside unit with "front" mark facing the front of the unit

Appendix C
Analytical Standard Operating Procedures

STANDARD OPERATING PROCEDURE FOR THE ANALYSIS OF
RESIDUE, NON-FILTERABLE (TOTAL SUSPENDED SOLIDS) in WATER
Standard Method 2540 D
(GRAVIMETRIC, 103 °C to 105 °C)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5 CHICAGO REGIONAL LABORATORY
536 SOUTH CLARK STREET (ML-10C)
CHICAGO, ILLINOIS 60605

EFFECTIVE:

EFFECTIVE DATE
NOV 0 1 2011
US EPA CRL

CONCURRENCE

PRIMARY ANALYST: Nidia Fuentes Date: 10/14/11

GROUP LEADER: Frann A. Bruna Date: 10/14/2011

CRL QA COORDINATOR: [signature] Date: 10/14/11

CRL DEPUTY DIRECTOR: [signature] Date: 10/14/2011

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1. SCOPE AND APPLICATION :

1.1. This method tests for Residue, Non-Filterable (Total Suspended Solids) in drinking, surface, and saline water; domestic and industrial wastes. It is approved for NPDES compliance monitoring.

1.2. The practical range of the determination is 2 mg/L to 2000 mg/L.

1.3. The reporting limit is 5 mg/L.

1.4. No MDL required. Balance requires 0.1 mg sensitivity.

1.5. Single laboratory uncertainty for this method determined following CRL.SOP GEN006 (statistical method, page 11) at the 95% confidence interval using laboratory control sample at 44.8 mg/L was found to have an uncertainty of 1.33mg/L. The uncertainty may be greater near the reporting limits and much larger near the detection limits. See Appendix B for data points used.

2. SUMMARY OF METHOD:

2.1. A representative sample is filtered through a glass fiber filter. The residue retained on the filter is dried to constant weight at 103 °C to 105 °C.

2.2. The filtrate from this method may be used for Residue, Filterable (Total Dissolved Solids).

2.3. Standard Method 2540D is used for all NPDES and enforcement samples. Graduated cylinders are used for measuring samples and provide appropriate accuracy. Refer to Section 11.2 for the sample preparation procedure.

3. DEFINITIONS:

3.1. LABORATORY REAGENT BLANK (BLK) – An aliquot of reagent water, or other blank matrices that are treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, internal standards, and surrogates that are used with other samples. The BLK is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or apparatus.

3.2. STANDARD REFERENCE MATERIAL (SRM) – A type of QUALITY CONTROL STANDARD (QCS) or solution of method analytes of known concentration that is used to check laboratory performance with externally prepared test materials. The SRM is obtained from a source external to the laboratory and different from the source of calibration standards.

3.3. LABORATORY DUPLICATE (DUP) – Two aliquots of the same sample taken in the laboratory and analyzed separately with identical procedures. Analysis of a sample and its duplicate indicate precision associated with the laboratory procedures, but not with sample collection, preservation, or storage procedures.

3.4. MATERIAL SAFETY DATA SHEET (MSDS) – Written information provided by vendors concerning a chemical's toxicity, health hazards, physical properties, fire, and reactivity data including storage, spill, and handling precautions.

4. SAFETY AND WASTE HANDLING:

4.1. Good laboratory practices must be maintained.

4.2. Report all major spills and injuries.

4.3. Discard sample and standard waste in a blue labeled waste container.

4.4. All other wastes produced in performing this method must be disposed of according to the Chicago Regional Laboratory Chemical Hygiene Plan.

5. INTERFERENCES:

5.1. The apparatus, procedure, and drying temperature are specified since these variables can affect the results.

5.2. Samples which are high in dissolved solids may result in a positive interference. Sample size adjustment and careful post-washing are required.

5.3. Non-representative material, such as leaves, sticks, fish, fecal matter, etc., should be removed from the sample prior to analysis unless it is determined that they should be included in the final result.

6. APPARATUS:

6.1. Calibrated Support Equipment:

6.1.1. Analytical balance – capable of weighing to 0.1 mg. Certified yearly by vendor.

6.1.2. Drying oven – capable of maintaining temperature between 103 °C and 105 °C. Oven is checked with a certified thermometer monthly at the required temperatures.

6.2. Glass fiber filter discs – 4.7 cm, without organic binders.

6.2.1. Whatman type GF/C or Gelman type A-E, or equivalent.

6.2.2. Pre-weighed filters – Environmental Express Part # F93447mm or equivalent.

6.3. Filtration apparatus – including a filter holder, fritted glass filter support, filtration flask and clamp (Millipore XX1504700 or equivalent).

6.4. Aluminum pans are recommended for holding the filters during the drying and cooling process.

6.5. Laboratory vacuum supply.

6.6. Desiccators.

6.7. Graduated Cylinders – 100 mL in volume.

7. REAGENTS:

7.1. Reagent Water – ASTM type II water or equivalent.

7.2. Standard Reference Material (SRM) – Environmental Resource Associates, Cat. No. 507 or equivalent.

7.2.1. Expiration date is given by the manufacturer.

7.2.2. All SRM certificates are filed and kept for record purposes.

8. SAMPLE HANDLING AND PRESERVATION:

8.1. Samples are collected in glass or high density polyethylene containers.

8.2. Samples are stored at ≤ 6 °C. The holding time is 7 days.

8.3. Upon receipt, the samples are verified for proper preservation. If any sample is found to be improperly preserved or handled, the customer service liaison must be notified in order to determine the correct action.

9. QUALITY CONTROL:

9.1. Users of this method must operate a formal quality control (QC) program. The minimum requirements of this program consist of an initial demonstration of laboratory capability, the periodic analysis of laboratory reagent blanks, control standards, and other laboratory solutions as continuing check on performance. The user is required to maintain performance records that define the quality of the

data that are generated.

9.2. **INITIAL DEMONSTRATION OF PERFORMANCE:**

9.2.1. Prior to analyzing samples by this method, the following determinations and analysis must be successfully completed and documented.

9.2.1.1. Determination of the Linear Calibration Range (LCR).

9.2.1.2. Determination of Method Detection Limit (MDL).

9.2.1.3. Analysis of Standard Reference Material (SRM).

9.2.2. ***Determination of Linear Calibration Range (LCR):***

9.2.2.1. Prior to use, check the balance by weighing three Class "S" weights to cover the range of interest. Document data in a log book designated for the balance being used for analysis. Limits of acceptability are located in the front of the log book.

9.2.3. ***Determination of the Method Detection Limit (MDL):***

9.2.3.1. None required

9.2.3.2. Use an analytical balance capable of weighing to 0.1 mg.

9.2.4. ***Analysis of Standard Reference Material (SRM):***

9.2.4.1. Analyze one SRM per batch. Evaluate the results using the acceptance criteria provided by the manufacturer.

9.2.4.2. Maintain all determination and analysis information in a bench sheet (refer to Section 11.3).

9.3. **ANALYSIS OF PROFICIENCY TESTING SAMPLE (PT):**

9.3.1. The PT sample is a QCS provided by an external source and is analyzed biannually or as required. The PT sample is not like a regular sample and is analyzed singly without a duplicate or matrix spike. Evaluate the result using the acceptance criteria provided by the PT provider.

9.4. **ASSESSING LABORATORY PERFORMANCE:**

9.4.1. Refer to the table in Section 11.4 for QC frequencies and limit values.

9.4.2. If any of the preparation audits (BLK, SRM, or DUP) are found to be out of the limit during the analysis, repeat the measurement. If results are still out of limit, repeat drying cycle for evaporated sample. Evaluate the results against the stated limits.

9.4.3. If any of the failed preparation audits are still outside the limit, proceed with the rest of the analysis and evaluate the entire QC for the analysis.

9.4.4. When any or all of the preparation audits (BLK, SRM, or DUP) are out of the limit, it may be necessary to re-prepare all the affected batches. When it is determined that this is the case, use fresh clean glassware and filters. Verify that the laboratory water is of good quality, the standards are properly prepared, and all the equipments are functioning properly.

9.4.5. ***Laboratory Reagent Blank (BLK):***

9.4.5.1. At least one BLK must be analyzed per batch. Evaluate the result using the limit 0 ± 5 mg/L.

9.4.5.2. If the BLK is outside the limit, verify that there is no contamination. Use fresh clean glassware. Verify that the laboratory water is of good quality.

9.4.6. ***Blank Spike (BS):***

9.4.6.1. None required.

9.4.7. ***Instrument Performance Check (IPC) Solution:***

9.4.7.1. Verify balance and oven performances at the beginning of the analysis.

9.5. ASSESSING ANALYTE RECOVERY AND DATA QUALITY:

9.5.1. ***Laboratory Duplicate (DUP):***

9.5.1.1. Samples selected for duplicate analysis are designated by the sampling organization or the analyst if no designation is made.

9.5.1.2. If no designation is made by the sampling organization, a minimum of one duplicate must be analyzed for each sampling site.

9.5.1.3. Analyze at least one duplicate for each group of 20 samples or fewer collected. (Ex: 21 collected samples require 2 duplicates).

9.5.1.3.1. The sample aliquot taken for duplicate analysis must be from the same bottle as the sample.

9.5.1.4. Analyze the sample (S) and duplicate (DUP).

9.5.1.5. Calculate the Duplicate RPD by using the following equation:

$$RPD = \frac{|S - DUP|}{((S + DUP)/2)} \times 100\%$$

Where,

RPD = Relative percent difference.
S = Laboratory sample concentration (mg/L).
DUP = Laboratory sample duplicate concentration (mg/L).

9.5.1.6. Evaluate the duplicate difference using the limit RPD $\leq$ 20 %.

9.5.1.7. If the duplicate RPD is within the limits, no further action is required.

9.5.1.8. If the RPD is out of the limit and results are to be reported, the Group Leader will be notified with the analyst recommendation for a final evaluation of the data.

9.5.1.9. If the RPD is out of the limit and the sample results are close to the detection limit, calculate the absolute difference as follows;

$$\Delta = |S - DUP|$$

Where,

Δ = Absolute difference.
S = Laboratory sample concentration (mg/L).
DUP = Laboratory sample duplicate concentration (mg/L).

9.5.1.9.1. Evaluate the duplicate difference using the limit $\Delta \pm 5$ mg /L as follows;

9.5.1.9.2. Compare duplicate difference to the laboratory reagent blank.

9.5.1.9.3. If the duplicate difference Δ is within the limits, no further action is required.

9.5.1.9.4. If delta exceeds 0 ± 5 mg /L and results are reported, the Group Leader will be notified with the analyst recommendation for a final evaluation of the data.

9.5.2. ***Matrix Sample (MS);***

9.5.2.1. None required.

10. CALIBRATION AND STANDARDIZATION:

10.1. No calibration is required.

10.2. Verify that the balance is working properly by using standard weights (Refer to Section 9.2.2). Document balance ID on the bench sheet.

10.3. Verify from the oven log that the oven can maintain the required temperature for the duration of the analysis. On bench sheet, document which oven (by ID No.) is being used for analysis.

11. SAMPLE PREPARATION AND ANALYSIS:

11.1. ***Preparation of Glass Fiber Filter Discs:***

11.1.1. This process may be accomplished in one of two ways by either using manufacturer pre-weighed filters or having the analyst prepare the pre-weighed filters.

11.1.2. Pre-weighed Filters

11.1.2.1. Ready to use. Proceed to section 11.3

11.1.3. Preparation of Glass Fiber Filter Discs

11.1.3.1. Assemble the filtration apparatus with a filter disc in place (wrinkled side up; smooth side down) and turn on vacuum.

11.1.3.2. While vacuum is applied, wash the disc with 500 mL of reagent water. Continue to apply vacuum until all of the water is removed.

11.1.3.3. Turn off the vacuum.

11.1.3.4. Using forceps carefully remove the filter and transfer it to an aluminum pan.

11.1.3.5. Repeat steps 11.1.3.1 to 11.1.3.4 until all the filters are cleaned.

11.1.3.6. Drying Cycle:

11.1.3.6.1. Oven dry filters at 103 °C to 105 °C for one hour.

11.1.3.6.2. Cool dried filters in a dessicator for about an hour.

11.1.3.6.3. Weigh the filters immediately and record the results.

11.1.3.6.4. Repeat the drying cycle (11.1.3.6.1 to 11.1.3.6.3) until a constant weight is obtained.

11.1.3.6.4.1. A constant weight is obtained when the weight change is less than 4 % of the previous weight or 0.5 mg, whichever is less.

11.2. ***Preparation of Samples:***

11.2.1. Prior to filtering samples through glass fiber filter:

11.2.1.1. Assemble the filtration apparatus and turn on the vacuum.

11.2.1.2. Shake sample vigorously and quickly pour 100 mL of homogeneous sample into a graduated cylinder.

11.2.2. Filter the sample through the glass fiber filter.

11.2.2.1. After step 11.2.1.2, quickly pour sample into filtration apparatus and filter the sample through the glass fiber filter.

11.2.2.2. Continue to apply vacuum after the sample has passed through.

11.2.2.3. Wash the graduated cylinder and walls of the fritted glass filter support with three successive small portions of water, allowing complete drainage between washing.

11.2.2.4. Continue suction for about 3 minutes after filtration is complete and then remove filter to aluminum pan.

11.2.2.5. If the filtration time exceeds 10 minutes, use a smaller sample volume.

11.2.2.6. Repeat steps 11.2.2.1 to 11.2.2.4 until all the samples are prepared.

11.2.2.7. Prepare blanks, control standards, and duplicates in the same manner.

11.2.3. Final step: Drying Cycle

11.2.3.1. Refer to section 11.1.3.6.

11.3. For creating a bench sheet in LIMS, refer to Appendix A. The following information is recorded in LIMS or a generic Bench Sheet. :

A	B	C	D	E
Filter ID	Sample ID	Clean Filter Weight (g)	Dry Filter and Sample (g)	Sample Volume (mL)

A = The number on (side of) the aluminum dish in which the filters are placed in to dry.
B = The identification of the sample LIMS ID.
C = The weight of the dry filter after it has obtained a constant weight.
D = The weight of the dry filter after it has gone through its sample filtration process and has obtained a constant weight.

E = Sample volume.

11.4. The following audits are required:

Audit	Type	Frequency	Limits
SRM	Method	One per batch	Provided with standard
BLK	Method	One per batch	0 ± 5 mg/L
DUP	Method	Per site, and once for each group of 20 samples or fewer collected	RPD ≤ 20 % or Δ ± 5 mg/L

12. SAMPLE CALCULATIONS:

12.1. Calculate non-filterable residue as follows:

$$\frac{(A-B)\times 10^6}{C}$$

Where,

A = weight of filter + dried residue (g).
B = weight of filter (g).
C = volume of sample used (mL).

12.2. This calculation is automatically done in the electronic bench sheet once all weights have been entered. Refer to Appendix A for this procedure.

13. DATA REPORTING:

13.1. Data are reported to a maximum of three significant figures with no decimal places.

13.1.1. X, XX, or XXX0.

13.2. Results are reported based on the sensitivity of the balance used.

13.3. Sample results are reported in units of mg/L.

13.4. Customer receives final report and copy of narrative. Raw data, all potential bench sheets, QC summary sheets, and spreadsheets used are retained at the CRL official data files. CRL will submit all of these additional items to customer(s)

upon request.

13.5. Any irregularities in labeling or preservation of samples, or unusual observations must be documented in a case narrative and brought to the attention of the data user.

13.6. C_Analysis.rpt and/or C_AnalysisNoQC.rpt are the preferred report formats in LIMS.

13.7. All electronic records associated with any data package must be archived following CRL procedures.

13.8. Refer to CRL SOP GEN015 for data review process.

13.9. Refer to CRL SOP GEN001 for electronic data storage procedure.

13.10. Refer to Appendix A for LIMS entry and reporting procedure.

14. PREVENTATIVE MAINTENANCE:

14.1. Preventative maintenance records and log books are kept with the balances and ovens.

14.2. Annual certification for balance maintenance is done by an outside entity. Records are turned into the Quality Control Coordinator and kept with CRL official files.

15. TROUBLESHOOTING /CORRECTIVE ACTION:

15.1. Unacceptable duplicates may be caused by non-uniform samples. Homogenize all heterogeneous samples.

15.2. Low blanks and control standards may be caused by loss of filter material during handling. Be sure that the smooth side of the filter is down during filtration. Handle the filters carefully using forceps.

15.3. High results may be caused by a poor seal in the dessicator or by using expended drying agents.

15.4. Corrective action documentation is to be reported under CRL's database. Refer to QMP Section 10.7 for QA database location and instructions.

16. REFERENCES:

16.1. "Standard Methods for the Examination of Water and Wastewater"; 18th Edition, 1992 APHA-AWWA-WEF

17. APPENDICES:

APPENDIX A – LIMS Entry and Reporting

1. Creating a Bench Sheet:

1.1. Create a bench sheet describing the sample preparation procedure.

1.2. Refer to Section 9 of this SOP for general QC requirements, and Section 11.4 for a summary of audit types and frequency.

1.3. Make sure that the preparation date in LIMS bench sheet matches the actual preparation date on the laboratory bench sheet.

1.3.1. **Note:** By convention, if sample preparation proceeds overnight, the date preparation started is used in LIMS.

1.4. Once all entries are complete, save the bench sheet.

1.5. Next select the printer icon.

1.5.1. Under **Print Format**, select bch_C_AIG018_TSS.rpt.

1.5.2. Under **Export Program**, select BCH_WetChem.exe.

1.5.3. Select any printer and then preview the bench sheet.

1.5.4. A **BCH_QAAN** screen will come up, select TSS from the drop down menu and then DONE.

1.5.5. An **EDD Complete** screen will come up with the location that the electronic bench sheet is saved. Select Go To, find the correct bench sheet, and open it up (make sure to remember the location where the bench sheet is saved at).

1.5.6. Click on the Calculate box in the middle of the spreadsheet. The samples and QC entered in the bench sheet will automatically populate.

1.5.7. Select analyst, oven number, and balance number from the drop down menus.

1.5.8. Fill in all the information including preparation date, filter ID, clean filter weight, sample volume and the dried filter + sample weights with each weighing. Save bench sheet.

1.5.9. Save and print out the bench sheet each day that information is entered.

1.5.10. When the final weights have been entered, select the calculate button. This will calculate the TSS concentration in mg/L. Save and print out the final bench sheet with calculated results.

2. Data Entry:

2.1. When the data are ready to be entered, the bench sheet is called up into the Data Entry/Review module.

2.1.1. Under the Data Entry Tab, select the Open button and open up the bench sheet with all of the data from Section 1 of the Appendix. All the data will populate in the data entry table. Make sure that all the fields of the data entry are correct and save it.

2.1.2. After saving, proceed to the Review page by clicking Query on the second row. Verify that all conversions to reporting units and dilutions have been calculated correctly. Verify that reporting limits have been correctly applied. Flags may be added at this stage, following the guidance given in SOP GEN005. Before review by the peer, the data should be locked, and the status should be updated to Analyzed.

3. LIMS Report Generation

3.1. Once all data are entered with the status of Analyzed, prepare a draft report. In LIMS, select Project Management, then Reports. Choose the work order, the analysis, and select the report. The LIMS report chosen will typically be C_Analysis.rpt or C_AnalysisNoQC.rpt. The draft report does not need to be signed. It is only for the purpose of review.

3.2. After the peer reviewer has updated the status of the LIMS entries to Reviewed, the final report may be generated. The mode of generation of the report is the same as above, except Final Report or Modified Final Report is chosen. All pages of the report and the transmittal form must be signed and dated.

APPENDIX B – Uncertainty Data

Analyzed	SampleID	Analysis	Analyst	Result
May-10-10	B100526-SRM1	Solids, TSS	AA	41
May-13-10	B100529-SRM1	Solids, TSS	AT	40
May-13-10	B100529-SRM2	Solids, TSS	AT	38
May-13-10	B100529-SRM3	Solids, TSS	AT	42
May-13-10	B100529-SRM4	Solids, TSS	AT	39
May-18-10	B100538-SRM1	Solids, TSS	AT	39
Jun-18-10	B100632-SRM1	Solids, TSS	AA	41
Jul-23-10	B100730-SRM1	Solids, TSS	NF	47
Jul-22-10	B100736-SRM1	Solids, TSS	NF	38
Jul-26-10	B100744-SRM1	Solids, TSS	NF	35
Jul-27-10	B100748-SRM1	Solids, TSS	NF	37
Jul-27-10	B100748-SRM2	Solids, TSS	NF	42
Aug-02-10	B100803-SRM1	Solids, TSS	AA	40
Aug-03-10	B100804-SRM1	Solids, TSS	AA	41
Aug-05-10	B100824-SRM1	Solids, TSS	AT	41
Aug-24-10	B100836-SRM1	Solids, TSS	LW	38
Aug-11-10	B100846-SRM1	Solids, TSS	NF	35
Aug-24-10	B100878-SRM1	Solids, TSS	NF	39
Aug-24-10	B100878-SRM2	Solids, TSS	NF	42
Sep-02-10	B009012-SRM1	Solids, TSS	LW	34
Sep-07-10	B009019-SRM1	Solids, TSS	LW	38

n = 21		AVE =	39
T = 2.086		SDEV (s) =	2.924
Uncertainty Value = Ts/□n-1 =		1.33	

STANDARD OPERATING PROCEDURE FOR THE ANALYSIS OF

PARTICULATE MATTER AS PM_{10} and $PM_{2.5}$ IN ATMOSPHERE

(HIGH VOLUME SAMPLER)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5 CHICAGO REGIONAL LABORATORY
536 SOUTH CLARK STREET (ML-10C)
CHICAGO, ILLINOIS 60605

LAST APPROVAL: 23 August 2006
EFFECTIVE DATE:

EFFECTIVE DATE
APR 13 2011
US EPA CRL

This SOP has been reviewed. No significant changes are needed at this time. Small editorial or typographical errors may have been corrected. Control limits may have been revised with a change in revision number. This SOP is submitted in accordance with policies in the CRL QMP and SOP GEN 006

PRIMARY ANALYST: Nidia Fuentes TITLE: *Chemist* Date: 3/23/2011

GROUP LEADER: Francis A. Anyango TITLE: *Chemist* Date: 3/24/2011

CRL QA COORDINATOR: [signature] Date: 3/24/11

CRL DEPUTY DIRECTOR: [signature] Date: 3/29/2011

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1. SCOPE AND APPLICATION:

1.1 This method covers the determination of mass concentration of suspended particulate in air.

1.2 It is applicable to the determination of mass concentration of particulate matter in air as PM_{10} and $PM_{2.5}$ under 40 CFR Part 50 Appendix J and L respectively.

1.3 Mass concentrations of particles with diameters between 0.1 to 100 μm can be determined by this procedure.

1.4 No detection limit is required. Balances with sensitivity of 0.1 mg and 1 μg are used for PM_{10} and $PM_{2.5}$ respectively.

1.5 All suspended particle weights determined are reported.

1.6 Single laboratory uncertainty for this method (Attachment F, G, and H on pages 33, 35, and 37), were determined following CRL.SOP GEN006 (statistical method, page 13) at the 95% confidence interval using the precision of clean and exposed filters (PM_{10}) and clean filters ($PM_{2.5}$). Absolute differences of typical clean PM_{10} filters weighed by this procedure were found to have a mean of 0.3 mg and uncertainty of 0.1 mg. Those of exposed filters similarly weighed were found to be 0.3 mg with an uncertainty of 0.1 mg. The absolute differences of standard clean $PM_{2.5}$ filters were found to have a mean of 3 μg and uncertainty of 1 μg. The uncertainty may be greater in field samples where loss of volatile particulate matter may occur.

2. SUMMARY OF METHOD:

2.1 Clean filters are sent from the field office to the weighing laboratory. Prior to use, those filters are inspected, equilibrated and weighed. The weighed filters are returned to the field for exposure.

2.2 Exposure is accomplished by means of an air sampler which draws ambient air at a constant volumetric flow rate into a specially shaped inlet. Suspended particulate matter is separated into one or more pore sizes and collected on the clean filters within a specified sampling period. Each size fraction is collected on a separate filter.

2.3 Field exposed filters are returned to the weighing Laboratory. At the laboratory, the filters are moisture equilibrated and weighed to determine the net weight gain.

2.4 The mass concentration of particulate matter in ambient air is computed from the volume of air sampled and the amount of particulate matter collected on the

filters.

2.5 Specific field sampling parameters and requirements for equipment, flow rate, field data recorded, and other related information are contained in 40 CFR Part 50 Appendix J, L, and other documents incorporated by reference there in

3. DEFINITIONS:

3.1 STANDARD WEIGHT CHECK – "Standard weights" covering the expected measurement range and used to check the performance of the analytical balance particularly for PM_{10}. A clean filter instead of standard weights is used for $PM_{2.5}$ .This filter is kept at the weighing laboratory.

3.2 TARE WEIGHT B Weight of clean filters prepared to collect particulate matter samples.

3.3 TARE WEIGHT CHECK – Clean filters, re-weighed by a second analyst with identical procedure to determine reproducibility. Tare weight check indicates the precision associated with the measurement process.

3.4 GROSS WEIGHT – Weight of exposed filters returned from the field after exposure to the atmosphere for the purpose of collecting particulate matter.

3.5 GROSS WEIGHT CHECK - Exposed filters re-weighed by a second analyst with identical procedures to determine reproducibility. Gross weight check indicates precision associated with the laboratory procedures, but not with sample collection or storage procedures.

3.6 REJECT FILTER (RF) - An unusable filter according to observed defects listed in Appendix I, page 13 of this procedure. Such a filter is not sent to the field.

3.7 TOTAL SUSPENDED PARTICULATE (TSP) - Suspended particles with diameters between 0.1 Φm to 100 Φm that are collected for determination by this procedure.

3.8 MATERIAL SAFETY DATA SHEET (MSDS) -- Written information provided by vendors concerning a chemical=s toxicity, health hazards, physical properties, fire, and reactivity data including storage, spill, and handling precautions.

4. SAFETY AND WASTE HANDLING:

4.1 Follow good laboratory practice.

4.2 All waste produced are to be disposed of according to the Laboratory Safety, Health, and Environmental Compliance Manual.

5 INTERFERENCES:

5.1 Loss of volatile particles. Filters should be re-weighed as soon as practical.

5.2 Artifacts due to formation of gaseous by products. The sampling organization should use filters that meet required specifications to minimize the formation of artifacts. Refer to Reference section 16.1 of this procedure.

5.3 Humidity may cause positive or negative bias. Equilibration condition for clean and exposed filters should be uniform.

5.4 Filter Handling. Handle all filters carefully to avoid damage or loss of particulate matter collected.

5.5 Changing equipment. When possible, use the same apparatus and conditions, for clean and exposed filters to reduce variability that can affect results.

6. APPARATUS:

6.1 General equipment for PM_{10} and $PM_{2.5}$

6.1.1 An environmental chamber: LAB-LINE Model # 708ASDHPVR26 or equivalent capable of maintaining the following conditions;

6.1.1.1 Environmental chamber conditions for PM_{10}:

6.1.1.1.1 Temperature (T) ranges 15°C to 30°C.

6.1.1.1.2 Temperature control limit T; ± 3°C

6.1.1.1.3 Humidity range 20% to 45% Relative Humidity (RH).

6.1.1.1.4 Relative humidity control RH ± 5%.

6.1.1.2 Environmental chamber conditions for $PM_{2.5}$:

6.1.1.2.1 Temperature (T) ranges 20°C to 23°C.

6.1.1.2.2 Temperature control limit T ± 2°C

6.1.1.2.3 Humidity range 30% to 40% Relative Humidity (RH).

6.1.1.2.4 Relative humidity control RH ± 5%.

6.1.2 Light box of the type used to examine x-ray films, Lecture-Lite Model 012-24L.

6.1.3 Temperature and humidity data logger (Ecolog-Net LH2- Elpro-Buchs AG or equivalent) or chart recorder (Honeywell DR4300 or equivalent).

6.1.4 Static master (NRD LLC Model No. 2U500 or equivalent)

6.2 Specific PM_{10} apparatus:

6.2.1 Analytical balance; capable of weighing 0.1 milligrams (Mettler AB104-S or equivalent).

6.2.2 Balance accessories for holding 8" x 10" unfolded filters.

6.2.3 Filters - 8"x 10" glass-fiber, cellulose, Quartz, or other filter medium as appropriate. Clean filters are supplied by the field office responsible for collecting samples for particulate matter analysis.

6.3 Specific $PM_{2.5}$ Apparatus:

6.3.1 Analytical balance; capable of weighing 1.0 µg (Satorius PRO II or equivalent).

6.3.2 Filters - 2µm PTFE 46.2 mm PP Ring supported for $PM_{2.5}$ (Whatman Part No. 7592-104 or equivalent).

6.3.3 Balance accessories for holding 46.2 mm filters.

6.3.4 Tweezers.

7. REAGENTS AND STANDARDS:

7.1 None.

8 SAMPLE HANDLING AND PRESERVATION:

8.1 Clean filters are to be supplied by the field office to the weighing laboratory at

least one week prior to sample collection. At the laboratory, the filters are inspected (Appendix A), conditioned, and weighed. The weighed filters are sent back to the field office. Pre-sampling (tare) weighing of $PM_{2.5}$ filters shall be performed within 30 days of the sampling period. A similar time frame is recommended for PM_{10} filters. The weights are recorded on a Laboratory bench sheets or an appropriate log book. Refer to Appendix C.

8.2 After sampling, PM_{10} filters are folded lengthwise at the middle with the exposed side in. Each PM_{10} filter is stored in a separate manila folder. $PM_{2.5}$ filters remains in their cassettes which are stored in Petri dishes. Post sampling equilibration and weighing of $PM_{2.5}$ filters shall be completed within 240 hours (10 days) after the end of the sample period. A similar period is recommended for PM_{10} filters. Filters should be shipped to the weighing laboratory at the end of the sampling period. $PM_{2.5}$ filters should not be exposed to temperatures over 32°C upon retrieval from the samplers and during shipment. Archived $PM_{2.5}$ exposed filters are to be stored in clean dust-proof, covered containers at a temperature of 4 ± 3 °C.

8.3 Each sample should have the following information;

8.3.1 Identification number (sample I.D.).

8.3.2 Station location.

8.3.3 Filter number.

8.3.4 Starting time.

8.3.5 Stop time.

8.3.6 Initial and final flow rate (in M^3/min, if possible a flow rate chart should be provided).

8.3.7 Any unusual conditions that may affect the results. (e.g., subjective evaluation of pollution that day, construction activity, .etc.).

8.3.8 Signature of the operator.

8.4 Upon receipt, the samples are verified for proper handling, documentation, and checked for validity according to the requirement of section 8.5. If any sample is disqualified, the customer service liaison should be notified in order to determine an appropriate course of action.

8.5 Samples are to be checked for validity in the field and in the laboratory. A sample

is not valid if the following conditions are determined to exist.

8.5.1 Any part of the filter is missing.

8.5.2 There are tears in the filter.

8.5.3 The filter was misaligned on the sampler.

8.5.4 The gasket on the sampler leaked.

8.5.5 The sampler was run for more than 26 hours or less than 22 hours on a 24 hour run.

8.5.6 There is no flow chart enclosed for samplers where one is required.

8.5.7 There was an equipment failure which caused the marking pen or the blower not to operate.

8.5.8 The air flow was more than 60 cubic feet per minute or less than 20 cubic feet per minute.

8.5.9 There was insufficient information on the Data Record to identify the site or date.

8.5.10 Sampler was run on a non-scheduled day.

8.5.11 Wrong type of filter was used.

8.5.12 Filter was contaminated.

8.5.13 Particulate matter was lost from the filter.

9. QUALITY CONTROL:

9.1 Users of this method must operate a formal quality control (QC) program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and continuing check on performance. The user is required to maintain performance records that define the quality of the data that are generated.

9.2 All quality control limits are to be based on historical data generated by the user.

9.3 INITIAL DEMONSTRATION OF PERFORMANCE:

9.3.1 Prior to analyzing samples for PM_{10} or $PM_{2.5}$ by this method, check initial balance performances using three Class S weights.

9.3.1.1 ***PM_{10};*** Perform balance checks with weights of 1, 2, and 5 grams (Reviewed 7/27/06). Refer to section 10.3.

9.3.1.2 ***$PM_{2.5}$;*** Perform balance checks with weights of 50, 100, and 200 milligrams (Reviewed 7/27/06). Refer to section 10.3.

9.3.2 Maintain an annual balance certification program.

9.3.3 ***Determination of the Method Detection Limit (MDL):***

9.3.3.1 None required.

9.3.3.2 Determine the sensitivity based on the accuracy of the balance used. Use a balance that meet the requirement of section 6.2.

9.3.4 Maintain all determination and analysis information in a file or logbook.

9.3.5 ***Instrument Performance Check (IPC):***

Verify the balance and environmental chamber performances routinely and prior to the start of analysis.

9.4 ASSESSING LABORATORY PERFORMANCE (PM_{10}):

9.4.1 If any of the laboratory weighing audits, Tare weight (T) or Gross (G) weight checks is found to be out of the limit during analysis, repeat the measurement and evaluate the results against the stated limits.

9.4.2 When any of the laboratory weighing audits is still out of the limits, verify that the balance and environmental chamber are working properly and the filters are properly conditioned with no damage. Repeat the measurement. Evaluate the final results against the stated limits.

9.4.3 Tare weight checks (T):

9.4.3.1 Tare weight check is performed by a second analyst. Use the table in Appendix D to record measurement results.

9.4.3.2 Select 7 out of 100 clean filters for re-weighing.

9.4.3.3 Re-weigh the selected filter and record the second reading as

observed value.

9.4.4 Calculate differences using the equation:

$$D\ (mg) = (ORw - OBw)/1000$$

Where,

D = Absolute Difference (mg).
ORw = Original weight of clean filter (g), first analyst.
OBw = Observed weight, same clean filter (g), second analyst.

9.4.5 Evaluate the differences according to the limit given for each type of filter used. Follow the procedure given in section 9.4.6, 9.4.7, and 9.4.8.

9.4.6 ***Quartz filters:*** Limit **D ± 0.7** mg (Reviewed 7/27/06).

9.4.6.1 If the difference **D** is within the limits, no further action is required.

9.4.6.2 If **D** exceeds 0 ± 0.7 mg, then the entire batch must be re-weighed.

9.4.6.3 If **D** exceeds 0 ± 0.7 mg and filters are to be sent to the field for use, the Group Leader will be notified with the analyst recommendation for a final evaluation of the data.

9.4.7 ***Glass fiber filters:*** Limit **D ± 3** mg (No data to update limits).

9.4.7.1 If the difference **D** is within the limits, no further action is required.

9.4.7.2 If **D** exceeds 0 ± 3 mg, then the entire batch must be re-weighed.

9.4.7.3 If **D** exceeds 0 ± 3 mg and filters are to be sent to the field for use, the Group Leader will be notified with the analyst recommendation for a final evaluation of the data.

9.4.8 ***Cellulose filters:*** Limit **D ± 2** mg (No data to update limits).

9.4.8.1 If the difference is within the limits, no further action is required.

9.4.8.2 If **D** exceeds 0 ± 2 mg, then the entire batch must be re-weighed.

9.4.8.3 If **D** exceeds 0 ± 2 mg and filters are to be sent to the field, the

Group Leader will be notified with the analyst recommendation for a final evaluation of the data.

None required.

9.4.9 Gross Weight Check (G):

9.4.9.1 Gross weight check is performed by a second analyst. Use the table in Appendix D to record measurement results.

9.4.9.2 Select 4 out of 50 weighed exposed filters for re-weighing.

9.4.9.3 Re-weigh the selected filter and record the second reading as observed value.

9.4.9.4 Calculate a duplicate difference using the equation:

$$D\ (mg) = (ORw - OBw)/1000$$

Where,

D = Absolute Difference (mg).
ORw = Original weight of exposed filter (g), first analyst.
OBw = Observed weight, same exposed filter (g), second analyst.

9.4.10 Evaluate the duplicate difference according to the limit given for each type of filter used. Follow the procedures given in section 9.4.11, 9.4.12 and 9.4.13 for quartz, glass fiber, and cellulose filters respectively.

9.4.11 ***Quartz filters:*** Limit $\Delta \pm$ **0.7** mg (Reviewed 7/27/06).

9.4.11.1 If the weight difference Δ is within the limits, no further action is required.

9.4.11.2 If Δ exceeds 0 ± 0.7 mg, then the entire batch must be re-weighed.

9.4.11.3 If Δ exceeds 0 ± 0.7 mg and results are reported, the Group Leader will be notified with the analyst recommendation for a final evaluation of the data.

9.4.12 ***Glass fiber filters:*** Limit $\Delta \pm$ **5** mg. No data to update limits.

9.4.12.1 If the weight difference Δ is within the limits, no further action is required.

9.4.12.2 If Δ exceeds 0 ± 5 mg, then the entire batch must be re-weighed.

9.4.12.3 If Δ exceeds 0 ± 5 mg and results are reported, the Group Leader will be notified with the analyst recommendation for a final evaluation of the data.

9.4.13 ***Cellulose filters:*** Limit **Δ ± 2** mg. No data to update limits.

9.4.13.1 If the weight difference Δ is within the limits, no further action is required.

9.4.13.2 If Δ exceeds 0 ± 0.2 mg, then the entire batch must be re-weighed.

9.4.13.3 If Δ exceeds 0 ± 0.2 mg and results are to be reported, the Group Leader will be notified with the analyst recommendation for a final evaluation of the data.

9.5 ASSESSING LABORATORY PERFORMANCE ($PM_{2.5}$):

9.5.1 Use the form provided in Appendix E to record $PM_{2.5}$QC data.

9.5.2 OPERATOR QUALITY CONTROL:

9.5.2.1 ZERO CHECK VALUE

9.5.2.1.1 After every fifth sample, perform a zero QC check.

9.5.2.1.2 Tare a clean blank filter on the micro balance and record the balance zero. Evaluate the data using the limit 0 ± 4µg.

9.5.2.2 CALIBRATION CHECK VALUE

9.5.2.2.1 After every fifth sample, perform a calibration check.

9.5.2.2.2 Tare the micro balance and record the balance zero values. Evaluate the data using the limit 0 ± 4µg.

values. Evaluate the data using the limit 0 ± 4µg.

9.5.2.2.3 Place a 10 mg standard weight on the balance and record the reading. Evaluate the result using the limit 10 ± 2 µg.

9.5.2.2.4 When the zero and calibration QC checks are out of the limits, the previous five filters must be re-weighed after the appropriate corrective action.

9.5.2.3 When the zero and calibration QC checks are out of the limits, verify that the performance of the balance is not affected by electrostatic. Common symptoms of this problem include noisy read outs, drift, sudden read out shifts. Static may be reduced by placing a radioactive ionizing unit in the weighing chamber (section 6.1.4) and by the balance to pass filters over prior to weighing.

9.5.2.4 SECOND ANALYST QC CHECK

9.5.2.4.1 After the calibration check (section 9.6.1.2) is completed tare weigh one arbitrarily selected filter from a set of standard filters (10% of the total number of filters to be weighed). Do not use these filters for sampling since they represent a repetitive QC check.

9.5.2.4.2 Evaluate the result using the limit ± 20 µg. If the difference is out of the limit, trouble-shoot and re-weigh. Verify that static (section 9.6.1.2.5) is not a problem. Check the balance using standard weights in the measurement range. Ensure that filters are properly equilibrated and the same balance is used for re-weighing.

9.5.2.4.3 Re-weigh five to seven exposed and unexposed filters per balance each day of operation. Evaluate the tare result using the limit ± 20 µg. Because of loss of volatiles, no limit is set for exposed filters. Record all results in the Quality Control Log Form.

9.5.2.5 Calculate differences using the equation:

$$D\ (mg) = (ORw - OBw)$$

Where,
D = Absolute Difference (mg).
ORw = Original weight, clean or exposed filter (mg), first analyst.
OBw = Observed weight, same clean or exposed filter (mg), second analyst.

9.5.3 Evaluate the differences using the limit **D ± 0.020** mg (±20 µg) (Reviewed 7/27/06).

9.5.3.1 If the difference **D** is within the limits, no further action is required.

9.5.3.2 If **D** exceeds 0 ± 0.020 mg, then the entire batch must be re-weighed.

9.5.3.3 If **D** exceeds 0 ± 0.020 mg and filters are to be sent to the field for use, the Group Leader will be notified with the analyst recommendation for a final evaluation of the data.

10. CALIBRATION AND STANDARDIZATION:

10.1 No calibration is required but equipment to be used must be verified for proper performance.

10.2 ***Preparation and Verification of Environmental Chamber Conditions:***

10.2.1 Establish the following temperature and humidity conditions for an environmental chamber used for PM_{10}.

10.2.1.1 Temperature (T); 15°C to 30°C. Limit T ± 3°C.

10.2.1.2 Humidity; 20% to 45% RH. Limit RH ± 5%.

10.2.2 Establish the following temperature and humidity conditions for an environmental chamber used for $PM_{2.5}$.

10.2.2.1 Temperature (T); 20 °C to 23°C. Limit T ± 2°C.

10.2.2.2 Humidity; 30% to 40% RH. Limit RH ± 5%.

10.2.3 Verify that the data logger or thermo-humidigraph have been set to monitor the temperature and humidity of the chamber at the established settings.

10.2.4 Review the temperature humidity chart to verify that the environmental chamber can maintain the temperature and humidity settings.

10.2.5 Maintain a balance in the environmental chamber for weighing conditioned filters.

10.2.5.1 Verify that the balance is working properly using standard weights as given in section 10.3.

10.3 ***Balance verification:***

10.3.1 Before weighing any filter, check that a balance designated for use is working properly by using class-S weights at 1, 2, and 5 grams for PM_{10} and 50, 100, and 200 mg for $PM_{2.5}$.

10.3.2 Record the actual (A) and measured (M) weights, the date, and operators initials in the balance log book.

10.3.3 Calculate differences between A and M using the following equation;

$$D = A - M$$

Where,

D = Differences from actual weight (g (PM_{10}) or mg ($PM_{2.5}$)
A = Actual weight (g (PM_{10}) or mg ($PM_{2.5}$).
M = Measured weight (g (PM_{10}) or mg ($PM_{2.5}$)

10.3.4 Evaluate differences for the Limit D ± 0.5 mg (0.0005g) for PM_{10} and 20 µg (0.002 mg) for $PM_{2.5}$ (Reviewed 7/27/06).

10.3.5 If the differences are outside the limit and the balance is to be used for weighing filters, notify the Group Leader before proceeding.

11. SAMPLE ANALYSIS:

11.1 General preparation for PM_{10} and $PM_{2.5}$

11.1.1 Inspect clean filters supplied by the field office for initial weighing using a light-box for any visual defects according to Appendix A. Record the type of filter used in the Air Filter log book and the appropriate bench sheet.

11.1.2 Ensure that the environmental chamber has properly equilibrated according to section 10.2 for either PM_{10} or $PM_{2.5}$ analysis.

11.1.2.1 If you have not done so already, turn on the thermo-humidigraph to monitor the temperature and humidity of the environmental chamber at the established settings.

11.1.2.2 Make sure that the recorder pens on the thermo-humidigraph are working properly.

11.1.2.3 Make sure that the data logger is working properly.

11.1.3 Place clean or exposed filters on a filter rack in the equilibrated environmental chamber and condition the filters for at least 24 hours prior to performing initial weighing.

11.1.4 Batch samples in LIMS and Create LIMS Bench Sheet bch_C_AIG047_PM.rpt to record results.

11.2 Preparation of clean filters and weighing exposed PM_{10} filters.

11.2.1 Record measurement information following the format given in the table of section 11.4.

11.2.2 ***Weighing Clean Filters:*** Check the balance according to the procedure given in section 10.3. Once the balance has been properly verified, weighing clean filters can begin.

11.2.2.1 Select a clean conditioned filter for weighing.

11.2.2.2 Record the serial number of the filter as the filter I.D Number in the log book.

11.2.2.3 Weigh the filter to nearest mg.

11.2.2.4 Record the weight obtained in the Air Filter log book or Appendix C as the tare weight.

11.2.2.5 Label an envelope or box of similar size with the serial number of the weighed filter.

11.2.2.6 Place the filter in the envelope or box of similar size for return to field office for sampling.

11.2.2.7 Repeat section 11.2.2.1 to 11.2.2.6 until all the clean conditioned filters has been weighed.

11.2.3 Maintain a copy of the recorded filter weight, temperature, and humidity chart as part of the data package.

11.2.4 Preparation of exposed PM_{10} filters for final weighing.

11.2.4.1 After receipt of exposed filters from the field, process each sample as follows;

11.2.4.2 Remove an exposed filter folder from its shipping envelope.

11.2.4.3 Verify the filter serial number with the information recorded on the High Volume field data form and the Air Filter log book according. Refer to section 11.1.5.2. Notify the sampler if any discrepancy is observed.

11.2.4.4 Examine the shipping envelope. If sample materials have been dislodged from the filter onto the shipping envelope, recover as much as possible by brushing it from the envelope back onto the filter with a soft camel's hair brush.

11.2.4.5 Examine the filter with the naked eye to see if insects are embedded in the sample deposit. If insects are determined to be present, remove them with teflon tipped tweezers. Disturb the sample deposit as little as possible.

11.2.4.6 If more than 10 insects are observed, notify the Group Leader for a decision to accept or reject the sample after verification with the sampling organization. Refer to section 8. Record these observations under comments by the analysts.

11.2.4.7 Examine each filter according to section 8, especially sections 8.3 and 8.5.

11.2.4.8 Void the sample if required information cannot be obtained after inquiry has been made to the field operator.

11.2.4.9 Place exposed filters on a filter rack in an equilibrated environmental chamber and condition the filters for at least

24 hours. Weigh the exposed filters after equilibration is completed

11.2.5 Final weighing of exposed filters (Gross Weight)

11.2.5.1 Check the balance according to the procedure given in section 10.3.

11.2.5.2 Select an exposed conditioned filter for weighing.

11.2.5.3 Match the serial number of the exposed filter with that on the previous tare weight in the Air Filters log book or Appendix C.

11.2.5.4 Weigh the exposed filter to nearest mg.

11.2.5.5 Record the weight obtained as exposed weight.

11.2.5 6 Fold the filter lengthwise (section 8.2) at the middle with the exposed side in and return it to the original manila folder.

11.2.5.7 Repeat section 11.2.5.1 to 11.2.5.6 until all the samples has been weighed.

11.2.5.8 Quality Control summary:

Audit	Filter Type	Frequency	Limits	Updated/Reviewed
Clean Reproducibility Blank CRFM	Glass fiber	7/100 filters	0 ± 2 mg	Reviewed 2/28/11
	Quartz fiber	7/100 filters	0 ± 0.7 mg	Reviewed 2/28/11
	Cellulose	7/100 filters	0 ± 2 mg	Reviewed 2/28/11
Duplicates (LD)	Glass fiber	4/50 filters	Δ ± 2 mg	Reviewed 2/28/11
	Quartz fiber	7/100 filters	0 ± 0.7 mg	Reviewed 2/28/11
	Cellulose	4/50 filters	Δ ± 2 mg	Reviewed 2/28/11

11.3 Preparation of clean filters and weighing exposed $PM_{2.5}$ filters.

11.3.1 Weighing clean $PM_{2.5}$ filters.

11.3.1.1 The same analyst preparing and weighing the clean filters must weigh the exposed filters.

11.3.1.2 Check the balance and verify proper performance. Refer to section 10.3 for the appropriate procedure. Once the balance has been properly verified, select a clean conditioned filter for weighing.

11.3.1.3 Record the balance identification number, weighing date, and filter number in a log book or appropriate coding form. Refer to Appendix C.

11.3.1.4 Zero the balance and record the balance tare.

11.3.1.5 Weigh the filter to nearest mg and record the Tare Weight.

11.3.1.6 Placed the tared filter, with the reinforcing ring side up, in a comparably sized petri dish if a cassette is not immediately available.

11.3.1.7 When a cassette is available, install the filter into a cassette. Record the cassette and match it to the filter number. Return the filter/cassette assembly to its individual petri dish.

11.3.1.8 Maintain a copy of the coding form and the temperature - humidity chart as part of the data package.

11.3.1.9 Enclose a copy of the coding form with the weighed clean filters for shipment to the field sampler.

11.3.2 Preparation of exposed $PM_{2.5}$ filters for final weighing.

11.3.2.1 Exposed filters must be weighed by the same analyst who initially prepared the clean filters.

11.3.2.2 After receipt of exposed filters from the field, group filters according to their recorded balance numbers.

11.3.2.3 Place cassettes in an equilibrated environmental chamber. Refer to section 10.2.2

11.3.2.4 Cover the cassettes with clean lint free laboratory paper towel and place it in the conditioning environment. Allow

the filter to equilibrate according to the procedure outlined in subsection 10.2.2.

11.3.2.5 Examine each filter according to section 8, especially section 8.3 and 8.5.

11.3.2.6 Void the sample if required information cannot be obtained after inquiry has been made to the field operator.

11.3.2.7 Place exposed filters on a filter rack in an equilibrated environmental chamber and condition the filters for at least 24 hours. Weigh the exposed filters after equilibration is completed

11.3.3 Final weighing of exposed $PM_{2.5}$ filters (Gross Weight)

11.3.3.1 Exposed filters must be weighed by the same analyst who initially prepared the clean filters. Check the balance according to the procedure given in section 10.3.

11.3.3.2 Select an exposed conditioned filter for weighing.

11.3.3.3 Match the balance identification number, and filter number from the clean filter coding form from subsection 11.1.3.

11.3.3.4 Weigh the exposed filter to the nearest mg. Record the gross weight on the laboratory data/coding form (Appendix C).

11.3.3.5 Repeat section 11.3.3.1 to 11.3.3.4 until all exposed filters has been weighed.

11.3.3 6 Place weighed exposed filters back into corresponding Petri dish and return weighed filters back to the sample custodian for archiving.

12. CALCULATIONS:

12.1 PM_{10} and $PM_{2.5}$ Calculations:

12.1.1 The flow rate is to be provided by the field as part of the necessary sample information. Refer to section 8.3.5.

12.1.2 If the flow rate is provided proceed to section 12.3.

12.1.3 If flow rate is not provided and the information is to be determined from a flow chart, proceed to section 12.1.4.

12.1.4 Obtain a calibration curve for the appropriate sampler used by the field office with necessary instruction to determine flow rate from such curve. This information is supplied by the field.

12.1.4.1 Read the observed flow rate directly from a flow chart.

12.1.4.2 If the flow rate does not vary and decreases linearly, take the average of the initial and final readings.

12.1.4.3 If the flow rate decreases non-linearly, calculate hour by hour average.

12.1.4.4 Determine the flow rate from the calibration curve (section 12.2) supplied by the field with the necessary instruction.

12.1.4.5 Record the true flow rate in cubic feet per minute. Convert to M3/minute (ft3/min * 0.0283). Proceed to section 12.1.5.

12.1.5 Record the total sampling period in minutes from information provided by the field.

12.1.6 The total sampling period can also be obtained by calculating differences from information given in section 8.3.4 and 8.3.5.

$$\boxed{Sp\ (min) = [Te - Ts]}$$

Where,

Sp = Absolute sampling period in minutes
Te= Starting time.
Te = Stop time.

12.1.7 Calculate the PM_{10} concentrations as follows;

$$PM_{10}\ TSP\ (ug/m^3) = \frac{(We - Wt)*10^6}{(Sr \times Sp)}$$

Where,

We= Weight of the exposed filter in grams (g).
Wt= tare weight of filter in grams (g).
Sr = sampling rate (M3/min).
Sp = sampling period in minutes.

NOTE: If the PM_{10} filter medium is cellulose, a correction factor of 4 mg/l% relative humidity difference must be made in the weight difference. Cellulose filters gain or lose 4 mg/1% relative humidity increase or decrease, respectively.

12.1.8 Calculate the $PM_{2.5}$ concentrations as follows;

$$PM_{2.5}\ TSP\ (ug/m^3) = \frac{(We - Wt)}{(Sr * Sp)}$$

Where,

We= Weight of the exposed filter in milligrams (mg).
Wt= tare weight of filter in milligrams (mg).
Sr = sampling rate (M^3/min).
Sp = sampling period in minutes.

12.1.9 Suspended particles

12.1.9.1 Calculate the weight of suspended particles captured on exposed PM_{10} filter as follows;

$$SP\ (g/filter) = (We - Wt)$$

Where,

We = Weight of the exposed filter in grams (g).
Wt = tare weight of filter in grams (g).

12.1.9.2 Calculate the weight of suspended particles captured on exposed $PM_{2.5}$ filter as follows;

$$SP\ (mg/filter) = (We - Wt)$$

Where,

We = Weight of the exposed filter in milligrams (mg).
Wt = tare weight of filter in milligrams (mg).

13 DATA REPORTING:

13.1 All results are reported using LIMS as suspended particle (SP). Refer to Appendix B. All weights are reported. The weights are reported to a maximum of four decimal places as follows;

13.1.1 PM_{10} report results as X.XXXX.

13.1.2 $PM_{2.5}$ report results as X.XXX.

13.2 Data can also be calculated and reported as PM_{10} and $PM_{2.5}$ TSP to a maximum of three significant figures as follows;

13.2.1 X, XX, XXX, or XXX0.

13.3 Raw data and bench sheets are to be submitted with the data package.

13.4 Any irregularities in labeling or unusual observations must be documented in a case narrative and brought to the attention of the data user.

13.4 All electronic records associated with any data package generated must be archived following CRL.SOP GEN001.

13.5 All reviews are to be performed following the analytical procedure (CRL.SOP AIG047) and data review procedure (CRL.SOP GEN015).

13.6 Only final reports generated through LIMS are transmitted to the client. Raw data can be transmitted upon request.

14 PREVENTATIVE MAINTENANCE:

14.1 Preventative maintenance records and log book are kept with the balances and ovens.

15 TROUBLESHOOTING/CORRECTIVE ACTION:

15.1 If there is a static problem, an anti-static device can be placed within the balance chamber.

15.2 Document all corrective actions in the instrument log book describing the nature of the problems and steps taken to resolve the problem, and final solution

16 REFERENCES:

16.1 Code of Federal Regulations 40, Part 50.11, Appendix J, July 1, 1987, Pages 611 - 616.

16.2 Determination of TSP (Hi Volume Method), Texas Air Board, Laboratory Methods for Determination of Air Pollutants.

16.3 AElement DataSystem@, Ver 4.0, New User Tutorial, 1999 CequeLogic

APPENDIX A

Examination of Filters for Use

Filters should be handled with care during the examination. Use nylon, plastic or dust free gloves. Protect filters from dust or other contaminant at all times except during sampling or field exposure.

All filters are visually inspected for defects before the initial weighing. Visual inspection for defects shall be made using a light screen or table. The smooth (or back) side of the filters should be examined closely for loose fibers. Most of those fibers can and should be removed prior to weighing. Light finger pressure or the use of a small brush will remove most loose fibers. If a filter is found on which the loose fibers are too numerous or difficult to remove, the filter should be discarded.

A filter is rejected for use if any defects are found. Batches of filters containing a high number of defects should be returned to the supplier. The description of visual defects provided in section A (PM10) and B (PM2.5) of this attachment are used in the acceptance or rejection of filters and should be considered in recommendation for procurement of new filters.

Document the filter type, lot number, serial number of specific filters, and the type of defect found in a log book or appropriate laboratory bench sheet. Include the analyst initial and examination date. A defective filter is one that contains one or more visual defects not considered reject. Reject filters and defective filters are, therefore, mutually exclusive.

If, during the use of filters, other types of defects are encountered, a written description of the defect and information on the extent of the defect should be forwarded to the data user or weighing laboratory along with two filters exhibiting each type of defect. Any other comments or suggestions concerning the description and/or categorization of defective and reject filters should also be provided.

A. Filter integrity checks for PM10 filters using the High Volume Sampler

Each filter for PM10 sampling shall be visually inspected for the following defects;

16.1 Pinhole - a small hole that can be identified by examining both the front and back of the filter. A filter with such a defect is considered a reject filter.*

16.2 Line - occasionally a fine line created by the manufacturing screen across the filter. A filter with such a defect is considered a defective filter.*

3 Thin spot - a small area (slightly larger than pinhole) viewed from the filter back that appears to be weak. More light can be seen through this area than through the surrounding area. Viewed from the front there is no evidence of this problem.

There can be several spots per filter. A filter with such defects is considered defective.

13. Dense spot - viewed from the filter back, this appears as a dark area (approximately 1/8"-1/4" in diameter) without sharply defined edges. Viewed from the front, an accumulation of filter fibers can be seen. If there is only one dense spot per filter, and the area covered is small, the filter will be considered a defective filter. Any filter which contains more than one dense spot shall be considered reject.

14. Dark spot - these spots are distinguished from the dense spots in that such dark spots resemble "fly specks." There may be several per filter. Their presence results in a defective filter. Any filter containing more than two such dark spots will be considered reject.

15. Loose fiber on filter back - this appears as if a rough object had been moved across the filter back and loosened the filter base. If the number of fibers is small and can be brushed off, the defective filter can be used. If, in EPA's judgment, the fibers are too large or too numerous to remove, the filter will be considered reject.

16. Glass fiber - viewed from the back, this defect resembles a thin spot. The shape can be circular or oval. When rubbed, the glass may become detached. No evidence of this defect can be seen from the front. If it becomes detached and creates a pinhole, the filter is rejected. Otherwise, it is defective.

17. Coloration - yellow, red, or other colored spots. A filter with such colorations is considered reject.

18. Other - a filter with any imperfection not described above, such as frayed edges or indentations or the results of other poor workmanship may be considered defective.

B. Filter integrity check for PM2.5

Visual Inspection:

Specific defects to be observed for PM2.5 filters;

16.3 Pinhole - a small hole that can be identified by examining both the front and back of the filter. A small hole appearing (a) as a distinct and obvious bright point of light when examined over a light table or screen, or (b) as a dark spot when viewed over a black surface. A filter with such a defect is considered a reject filter.*

16.4 Separation of ring – Any separation or lack of seal between the filter and the filter

border reinforcing ring. A filter with such a defect is considered a defective filter.*

3 Chaff or flashing – Any extra attached residual material on the reinforcing polyolefin ring, or heat seal that would prevent an air tight seal when the ring is placed under compression.

4 Loose material – Any extra or loose material or dirt particles on filter that require removal by brushing prior to weighing.

5 Discoloration – Any obvious visible discoloration that might be evidence of a contaminant.

6 Filter non-uniformity – Any obvious visible non-uniformity in the appearance of the filter when viewed over a light table or black surface that might indicate gradations in porosity across the face of the filter.

7 Other - A filter with any imperfection not described above, such as irregular surfaces or other poor workmanship may be considered defective.

APPENDIX B

LIMS ENTRY AND REPORTING;

1.0 CRL uses Element DataSystem (ElmNT). Refer to Element DataSystem, version 4.0, New User Tutorial (CequeLogic) and associated references as necessary.

1.2 ***Creating a bench sheet;***

1.2.1 Create a bench sheet describing the sample preparation procedure.

1.2.2 Refer to section 9 of this SOP for general QC requirements, and section 11.4 for a summary of audit types and frequency.

1.2.3 Make sure that the preparation date in LIMS bench sheet matches the actual preparation date on the laboratory bench sheet.

Note: By convention, if the sample preparation proceeds overnight, the date started is used for the LIMS preparation date.

1.2.4 After selecting DONE, ElmNT automatically create and save a file for the bench sheet just prepared.

1.3 ***Data entry;***

1.3.1 From the ElmNT pull down menu, select Laboratory, Data Entry/Review, and the bench sheets created in section 1.2 if it is not already selected for you.

Note: All analyses or selected analyses can be included.

1.3.2 Data is entered manually. Enter the results in the column **Result** in g units. For each result, enter the date of analysis in the column **Analyzed**.

1.3.3 When all data are entered, click the **Save** button on the top row. After saving, proceed to the Review page by clicking **Query** on the second row. Verify that all conversions to reporting units have been calculated correctly. Verify that reporting limits have been correctly applied. Flags may be added at this stage, following the guidance given in SOP GEN015. Before review by the peer, The data may be locked, and the status should be updated to Analyzed.

1.4 ***Report Generation;***

1.4.1 Preparation of a draft report:

1.4.1.1 Ensure that all data are entered with the status of Analyzed.

1.4.1.2 From ElmNT pull down menu, select Project Management and then Reports.

1.4.1.3 Choose the work order number, analysis, and standard report format. Choose C_Analysis.rpt format for PM10. Select Draft report.

Note: This draft report need not be signed. It is only for the purpose of review.

1.4.1.4 Submit the draft report with the data package to a peer reviewer.

1.4.1.5 After completing the data review, the peer reviewer updates the status of the LIMS entries to Reviewed.

1.4.2 Preparation of a final report:

1.4.2.1 After the peer reviewer has updated the status of the LIMS entries to Reviewed, a final report may be generated.

1.4.2.2 Ensure that all data are now in Reviewed status. Refer to section 1.4.1.2 and 1.4.1.3 of this appendix for generation of the report. Select Final Report or Modified Final Report is chosen. All pages of the report and the transmittal form must be signed and dated by the analyst.

APPENDIX C

CENTRAL REGIONAL LABORATORY
Region V
Coding Form for $PM_{2.5}$ by CRL.SOP AIG047

Balance ID Number:
Balance Operator:

Date	Cassette No.	Filter No.	Balance Tare (mg)	Tare Weight (mg)	Gross Weight (mg)	Analyst Initials

APPENDIX D

CENTRAL REGIONAL LABORATORY
Region V
Coding Form for PM_{10} by CRL.SOP AIG047

Balance ID Number:
Balance Operator:

Date	Filter ID	Filter Tare Weight (g)	Tare Weight Duplicate(g)	Filter Gross Weight (g)	Gross Weight Duplicate (g)	Analyst Initials

APPENDIX E
CENTRAL REGIONAL LABORATORY
Region V
Quality Control Log for PM_{10} (CRL.SOP AIG047)

Analyst QC Check							Second Analyst QC Check				
Balance ID Number:							Balance ID Number:				
Balance Operator:											
	Standard Weight Checks		Zero Check (± 0.5 mg)		Calibration Check (± 0.5 mg)		Tare and Gross Weight Checks				
Date	Original Value (g)	Observed Value (g)	Original Value (g)	Observed Value (g)	Observed Value (g)	Original value (g)	Filter ID	Original Value (g)	Observed Value (g)	Tare (T) or Gross (G)	Analyst Initials

APPENDIX F
CENTRAL REGIONAL LABORATORY
Region V
Quality Control Log for $PM_{2.5}$ (CRL.SOP AIG047)

Second analyst QC Check						Analyst QC Check			
Balance ID Number:						Balance ID Number:			
Balance Operator:						Balance Operator:			
Date	Filter No.	Original Value	Observed Value	± 20µg Y/N	Action Taken	Date	Filter No.	Zero Check Value[a]	Cal Check Value[b]

[a] ± 4 µg of zero
[b] ± 2 µg of 10 mg

APPENDIX G
MEASUREMENT UNCERTAINTY (PM_{10}) CLEAN FILTERS

Count	Date	Filter ID	Original weight (g)	Observed weight (g)	Abs Diff (mg)
1	1/30/2002	Q6279975	4.3479	4.3482	0.30
2	1/30/2002	Q6279968	4.3362	4.3364	0.20
3	1/30/2002	Q6279962	4.3820	4.3821	0.10
4	4/9/2002	Q6809572	4.3980	4.3983	0.30
5	4/9/2002	Q6809560	4.3683	4.3687	0.40
6	6/11/2002	Q6809540	4.3896	4.3893	0.30
7	6/11/2002	Q6809550	4.3860	4.3863	0.30
8	7/26/2002	Q6597471	4.4502	4.4506	0.40
9	7/26/2002	Q6597493	4.4035	4.4040	0.50
10	7/26/2002	Q6597489	4.4134	4.4133	0.10
11	8/16/2002	Q6597465	4.4245	4.4250	0.50
12	8/16/2002	Q6597451	4.4470	4.4473	0.30
13	8/16/2002	Q6597445	4.4067	4.4071	0.40
14	10/11/2002	Q6597439	4.4070	4.4070	0.00
15	10/11/2002	Q6597425	4.4614	4.4614	0.00
16	10/11/2002	Q6597414	4.4572	4.4568	0.40
17	11/14/2002	Q6700301	4.4844	4.4834	1.00
18	11/14/2002	Q6700299	4.4962	4.4952	1.00
19	11/14/2002	Q6700297	4.4220	4.4215	0.50
20	11/14/2002	Q6700295	4.4852	4.4850	0.20
21	2/6/2003	Q3020734	4.3525	4.3526	0.10
22	3/5/2003	Q3020693	4.3267	4.3267	0.00
23	3/5/2003	Q3020706	4.3450	4.3449	0.10
24	4/9/2003	Q3020671	4.3457	4.3463	0.60
25	4/9/2003	Q3020676	4.3661	4.3662	0.10
26	5/12/2003	Q3021292	4.3080	4.3082	0.20
27	5/12/2003	Q3021301	4.3013	4.3012	0.10
28	6/9/2003	Q3021262	4.3610	4.3614	0.40
29	6/9/2003	Q3021267	4.2985	4.2983	0.20
30	6/9/2003	Q3021278	4.3080	4.3085	0.50
31	7/22/2003	Q3021257	4.3050	4.3046	0.40
32	7/22/2003	Q3080722	4.3637	4.3636	0.10
33	9/15/2003	Q3012010	4.2739	4.2738	0.10
34	9/15/2003	Q3012022	4.1817	4.1820	0.30
35	10/9/2003	Q3080695	4.3678	4.3674	0.40
36	10/9/2003	Q3080705	4.3665	4.3665	0.00
37	11/20/2002	Q3080666	4.3799	4.3780	1.90
38	11/20/2002	Q3080678	4.3651	4.3651	0.00

SUMMARY STATISTICS FOR UNCERTAINTY PM_{10}, CLEAN FILTERS:

Average	0.33
Standard Deviation (s)	0.35
Student t-value	2.021
Uncertainty (mg)	0.115

APPENDIX H
MEASUREMENT UNCERTAINTY (PM_{10}) EXPOSED FILTERS

Count	Date	Filter ID	Original weight	Observed weight	Abs Diff
			(g)	(g)	(mg)
1	2/27/2002	Q2680087	4.3952	4.3954	0.20
2	2/27/2002	Q6280004	4.3804	4.3807	0.30
3	3/6/2002	Q6280124	4.4085	4.4084	0.10
4	3/6/2002	Q6280125	4.4080	4.4075	0.50
5	3/6/2002	Q6280123	4.4277	4.4281	0.40
6	3/26/2002	Q6279981	4.3641	4.3643	0.20
7	4/9/2002	Q6279978	4.3442	4.3441	0.10
8	4/9/2002	Q6279962	4.3917	4.3915	0.20
9	4/9/2002	Q6279958	4.4328	4.4328	0.00
10	4/9/2002	Q6809577	4.4346	4.4342	0.40
11	5/22/2002	Q6279995	4.3657	4.3662	0.50
12	5/22/2002	Q6279991	4.3634	4.3638	0.40
13	5/22/2002	Q6279983	4.3910	4.3914	0.40
14	6/12/2002	Q8609564	4.4429	4.4425	0.40
15	6/12/2002	Q8609559	4.3767	4.3762	0.50
16	6/27/2002	Q8609546	4.4171	4.4169	0.20
17	7/22/2002	Q8609541	4.4431	4.4430	0.10
18	7/22/2002	Q8609548	4.4291	4.4292	0.10
19	7/22/2002	Q8609552	4.4318	4.4318	0.00
20	8/16/2002	Q6597471	4.4799	4.4800	0.10
21	8/16/2002	Q6597484	4.4425	4.4430	0.50
22	10/17/2002	Q6597456	4.4889	4.4889	0.00
23	10/17/2002	Q6597446	4.4815	4.4824	0.90
24	12/20/2002	Q6700325	4.4699	4.4704	0.50
25	12/20/2002	Q6700320	4.4606	4.4607	0.10
26	12/20/2002	Q6700319	4.4750	4.4752	0.20
27	2/5/2003	Q6700324	4.4920	4.4916	0.40
28	2/21/2003	Q6700300	4.4908	4.4907	0.10
29	2/21/2003	Q6700285	4.4808	4.4812	0.40
30	4/10/2003	Q3020729	4.3681	4.3683	0.20
31	4/10/2003	Q3020727	4.3508	4.3502	0.60
32	4/18/2003	Q3021319	4.3192	4.3190	0.20
33	4/25/2003	Q3020708	4.3725	4.3717	0.80
34	4/25/2003	Q3020708	4.3717	4.3720	0.30
35	5/22/2003	Q3020698	4.3500	4.3496	0.40
36	5/22/2003	Q3020700	4.4020	4.4021	0.10
37	7/24/2003	Q3020694	4.3677	4.3673	0.40
38	7/24/2003	Q3020675	4.3698	4.3696	0.20

39	8/15/2003	Q3021294	4.3812	4.3811	0.10
40	8/15/2003	Q3021304	4.3313	4.3309	0.40
41	9/22/2003	Q3021262	4.3903	4.3900	0.30
42	11/14/2003	Q3080726	4.3915	4.3910	0.50
43	12/17/2003	Q3080698	4.3835	4.3830	0.50
44	12/17/2003	Q3080701	4.3797	4.3797	0.00

SUMMARY STATISTICS FOR UNCERTAINTY (PM_{10}) EXPOSED FILTERS

Average	0.30
Standard Deviation (s)	0.21
Student t-value (t)	1.960
Uncertainty (mg)	0.062

APPENDIX H
MEASUREMENT UNCERTAINTY ($PM_{2.5}$) CLEAN FILTERS

Count	Date	Filter ID	Original (mg)	Observed (mg)	Abs Diff (µg)
1	4/5/2006	005585	144.426	144.423	3.0
2	4/5/2006	011354	145.871	145.876	5.0
3	6/7/2006	028314	150.616	150.621	5.0
4	6/8/2006	090723	144.130	144.132	2.0
5	6/29/2006	P6019323	142.723	142.719	4.0
6	7/20/2006	P6019323	142.732	142.733	1.0
7	8/15/2006	P6019323	142.736	142.734	2.0
8	8/15/2006	P6019300	145.095	145.099	4.0
9	8/15/2006	P6019294	145.090	145.087	3.0
10	8/15/2006	P6019278	141.892	141.894	2.0
11	8/15/2006	P6019323	142.734	142.735	1.0
12	8/15/2006	P6019283	145.369	145.361	8.0
13	8/16/2006	P6019323	142.735	142.731	4.0
			Average		3.4
			Standard Deviation (s)		1.9
			Student t-value		2.179
			Uncertainty (ug)		1.148